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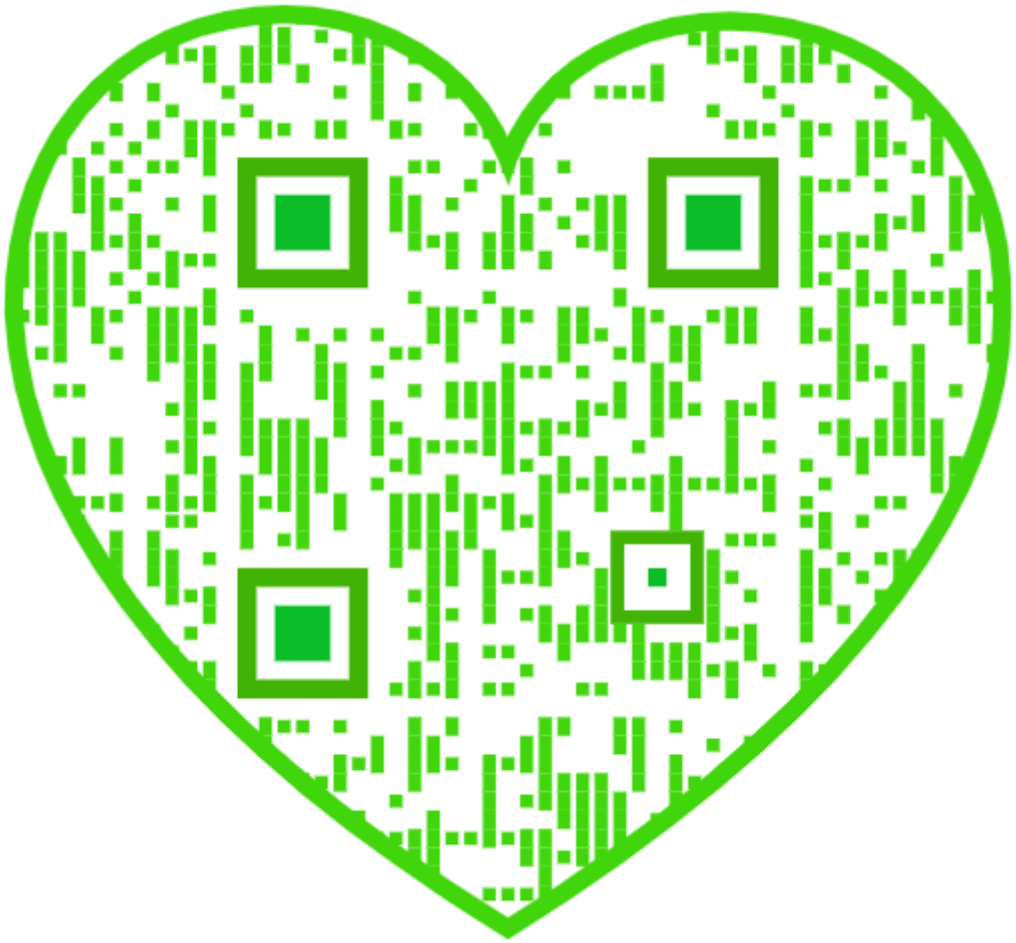
WOODWORK and Mechanical Drawing

BY

WILLIAM PAUL FOX

FOX BROTHERS, PUBLISHERS



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WOODWORK

and

Mechanical Drawing

BY

WILLIAM PAUL FOX

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TO THE TEACHER

MANUAL TRAINING as a school study has successfully passed the stage of experimental teaching and reached a recognition that requires neither defense nor apology. But there remains, as in all school work, a distinct necessity for relating it to the every-day needs and desires of the child, not so much the young child as the developing child in his teens. To meet these needs by stimulating inquiry and promoting activity along the line of directed work is the aim of the author. The desire for the beautiful is also met by the large number of projects offered, among which the pupil is left free to select the ones he admires for construction.

Mechanical drawing is a necessary adjunct of good manual training; the eye must aid the hand in the task set by the brain. The exercises presented are designed to promote that skill which in time would make the youthful worker able to select and prepare his own drawing and to apply his knowledge to any problem he may encounter.

Tools, hardware, stains, waxes, and lumber, in so far as they come under the observation of the young student, receive mention.

No attempt has been made to formulate a hard and fast text; on the contrary the natural limitations incidental to widely differing school districts have been kept in mind. It is hoped the teacher will not only permit but encourage the greatest possible freedom of choice in selecting the task.

The author gratefully acknowledges his indebtedness for suggestions and advice to many friendly sources—notably, John J. Fox, John S. Kief, Walter H. Aitken, John T. Driscoll, and Mary E. Tobin.

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SAWS

Saws may be divided into two groups; first, power saws, such as band and circular saws; second, all kinds of hand saws. The second group is used in manual training. They are classified as follows:

(1) **The Cross-cut Saw,** for cutting across the grain of the wood. The teeth of this saw are sharp pointed, Fig. 1, and act like so many knives cutting a double knife line across the board. The sharp point cuts, and the body of the tooth tears out the wood between the knife lines.

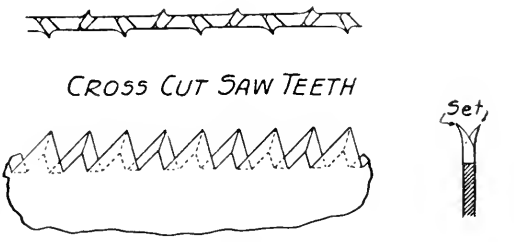


FIG. 1

(2) **The Rip Saw,** for cutting in line with the grain of the wood. This saw has chisel-pointed teeth, Fig. 2. Each tooth cuts like a small chisel. A rip saw must be used in line **with,** not **across,** the grain of the wood.

(3) **The Back Saw,** for fine, accurate cutting and fitting. This is a cross-cut saw with a steel back to stiffen the blade. It has very small teeth, which are not **set,** but depend for their clearance upon the wire edges left by the file in sharpening; may be used for either ripping or cross-cutting.

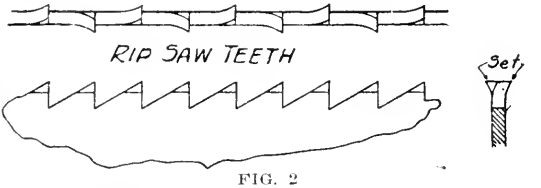


FIG. 2

(4) **The Turning Saw,** for circular and irregular shaped cutting. This saw has a blade 12 or 14 inches long, and from $\frac{1}{8}$″ to $\frac{5}{16}$″ wide, with rip saw teeth, and adjustable handles. The frame is wood, with an iron or rope tie-bar.

(5) **The Coping Saw,** for circular and irregular shaped cutting of thin boards. This saw has a narrow blade about $\frac{1}{32}$″ wide, with small teeth, and a metal frame.

It is very important that a saw should be set correctly, that is, it must cut easily without binding. A saw that is properly sharpened must be set with every alternate tooth projecting to one side. The other teeth must be bent slightly in the opposite direction, Figs. 1 and 2.

FIG. 3

FIG. 4

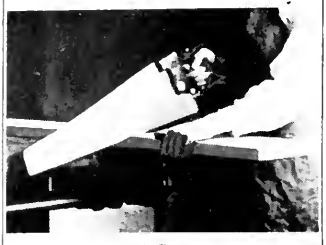


FIG. 5

FIG. 6

FIG. 7

LESSON NO. 2

EXERCISE IN LAYING OUT AND SAWING

1. Measuring from one end of the board, lay out the length given by the instructor. Use a two-foot four-fold rule and lay on edge so that the divisions on the rule are against the boards, Fig. 3. This is the correct way to use this type of rule for accurate measuring.

2. Place handle of try square against one edge of the board and with pencil mark across the board, Fig. 4. Mark in this manner all boards which are to be squared. Never saw a board without first drawing a line. In ordinary work a good test of accuracy is to saw this line completely out; that is, it should not show anywhere after the cutting is completed.

3. Lay the board on top of the bench with line to be sawed outside the edge of the bench. If the board is a short piece, place it in vise instead of on top of the bench. The weight of a long board held by the hand secures firmness so that a vise is not needed.

4. Start the saw by drawing the first few strokes towards the body. Then push steadily away along the marked line, Fig. 5. Do not press down on the saw; it cuts on the forward and not on the backward stroke.

5. Set the marking gauge at the width given by the instructor. Mark this width on board, Fig. 6.

6. Place board in the vise, and with a rip saw cut along the line, Fig. 7.

Save this board for planing exercise.

LESSON NO. 3

THE PLANE

1. **Study carefully the drawing** of the plane and its parts, Plate 1. Note the lateral adjusting lever, adjusting nut, the frog, the Y adjustment, the plane iron, cap iron, cap, the double plane iron (which is the plane iron and cap iron together), the knob, and the handle.

2. **To sharpen** the plane take apart and remove the double plane iron. Loosen the cap iron screw which holds the plane iron to the cap iron. The plane iron is the only part which is sharpened. If the bevel on plane iron is too rounded or too short from sharpening on oil stone very often, have it ground again. The bevel should be about 25° or $\frac{3}{16}$″ to ¼″ long.

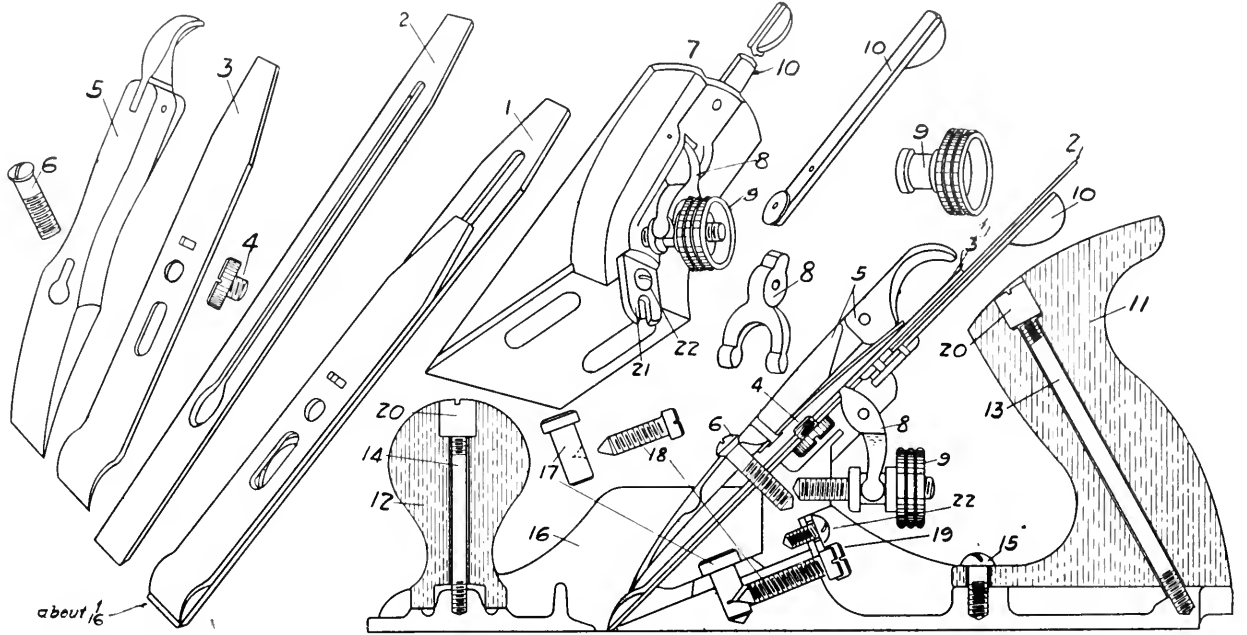
FIG. 8

FIG. 9

FIG. 10

3. **Grinding**—Place the plane iron against a tool rest set at a distance suitable to obtain the bevel wanted, Fig. 8. The tool rest shown is a strip of wood nailed to the grindstone frame. Grindstones having cast iron frames sometimes have adjustable tool rests. Hold the plane iron against the stone with both hands and grind the edge square and straight. The safe way is to have the stone turn away from you, though it cuts much faster when it is turning toward you, which is the way mechanics use it.

4. **Oil Stoning**—Grinding does not sufficiently sharpen a plane; it only gives the correct bevel. To sharpen a plane iron hold in both hands on the oil stone at the same angle as the bevel of the plane iron, and rub on the stone, Fig. 9, until you raise a feather or wire edge, that is, until you can feel the metal turned over on the straight side of the plane iron. Do not make the feather edge large, as it is unnecessary. Press harder on each edge in order to round the corners a trifle so as not to dig into the wood and cause ridges. Turn the plane iron over and hold perfectly flat on the straight side and rub, Fig. 10, until



1 Double Plane Iron
2 Single Plane Iron
3 Plane Iron Cap
4 Cap Screw
5 Lever Cap
6 Lever Cap Screw
7 Frog Complete
8 "Y" Adjusting Lever
9 Adjusting Nut
10 Lateral Adjusting Lever
11 Plane Handle
12 Plane Knob
13 Handle Bolt
14 Knob Bolt
15 Plane Handle Screw
16 Plane Bottom
17 Frog Pin
18 Frog Clamping Screw
19 Frog Adjusting Screw
20 Handle and Knob Nut
21 Frog Adjusting Plate
22 Frog Adjusting Plate Screw

PLATE 1

the feather edge disappears on that side. You will be able to feel it on the beveled side now. Turn the plane iron over again on the beveled side and rub a few strokes. Continue these operations until the feather edge disappears entirely. Feel for it on both sides, but be careful not to cut your fingers.

FIG. 11

5. **Adjusting the Plane**—The adjusting nut is for gauging the thickness of the shaving the plane is to cut. An easy way to set a plane is to draw the plane iron up by means of the adjusting nut until it is even with the bottom of the plane. Then carefully turn the adjusting nut while moving the plane across the board until the shaving is of the proper thickness. If the plane cuts on either edge of the blade instead of the center, turn the lateral adjustment toward the edge that it is cutting until the shavings are being cut in the middle of the plane iron. Always cut very thin shavings, and have your plane sharp.

FIG. 12

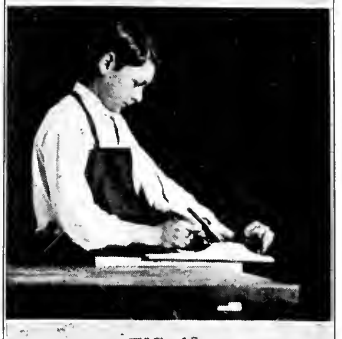


FIG. 13

6. **In using the plane** carefully follow the directions given below:

When in the position shown in Fig. 11, press down on the knob, and hold up the handle so that the bottom of the tool may be in the same plane as the surface of the board you are handling.

As your plane moves along the board and is in the position shown in Fig. 12, press on both knob and handle.

When the plane nears the position shown in Fig. 13, press on the handle and take the pressure off the knob.

FIG. 14

FIG. 15

FIG. 16

FIG. 17

LESSON NO. 4

TO SQUARE A BOARD

Lumber that is badly warped should not be used. A board 8″ wide should not be more than ⅛″ out of true. Lumber that is warped is sometimes flattened by steaming or soaking in water, and when thoroughly soaked is clamped flat and left to dry in a warm dry place, either in a dry kiln or near hot steam pipes. This is an expensive operation and is seldom done in shops, as the boards can be used by sawing them into narrow strips. If a board is warped considerably more than ⅛″ it is liable to crack in the assembling of the problem.

Dressed Lumber. Take any board and mark its concave surface; this is the working face. To find the concave face put the blade of a try square across the grain of the wood and test, Fig. 14.

1. Place the board in a vise and plane one edge straight, Fig. 15, and square with the working face (marked face), Fig. 16. This edge, which is straight and square with the concave surface, is known as the working edge. All measuring and testing are done with reference to this edge and the working face.

2. Chamfer corner opposite the working edge, not more than ¼″; less will do. This prevents splitting. Plane the end square with the working edge, Fig. 17, and the working face, Fig. 18. Plane from the working edge toward the chamfer.

3. Measure the length and mark it with try square and pencil, Fig. 19, from the trued end. Chamfer the other corner. Plane this end to length and test the same as for the first end. Square with the working edge, Fig. 17, and the working face, Fig. 18.

4. Set the marking gauge at the required width and from the working edge gauge the width, Fig. 20. If the board is wider than is required, saw with a rip saw to 1/8" from the gauge line. Plane to this line, and have the edge straight and square with the working face. It will also be square with both ends.

5. Take a fine shaving off each face to remove the dirt and machine planer marks, Fig. 21.

Another method is used when boards are so near the correct width that it would not be possible to cut the chamfers and plane them out, for when the board is completed there should be no chamfers left. In this second method the concave side is found and the working edge trued the same as in the first method. The ends are trued by planing about two-thirds across the ends from the working edge, then reversing and planing about two-thirds across from the other edge, Figs. 22 to 23. By taking a few shavings off first in one direction and then in the other the ends may be planed just as well as by the other method. After the ends are trued the board is proceeded with

FIG. 18

FIG. 19

FIG. 20

FIG. 21

FIG. 24

FIG. 25

in the same way as in the first method. This method is used almost entirely with expensive woods to save material.

There is a third method that is used when the lumber is not dressed, or when very accurate work is required. Instead of using the concave face as the working face, either one of the faces is used and planed flat. In testing, the try square is first placed across the grain, Fig. 14, and then diagonally across the grain, Fig. 24. This second test is to detect any twist in the board. This true face is used as the working face, and the planing is proceeded with in the same manner as in Methods 1 or 2. To plane the last face the marking gauge is set to the required thickness, Fig. 25, and the board planed to this gauge line. Pattern makers usually employ this method because of the extreme accuracy of their work.

A fourth method is sometimes used; the following being the order in which it is done: First, true face; second, true working edge; third, gauge width and true second edge; fourth, gauge thickness and true other face; fifth, true first end; sixth, true second end. This method is employed where a number of pieces of the same width are needed. Take a board equal to the length of the pieces required plus enough to allow for sawing and planing of ends. True both faces and edges. Cut to required lengths and true ends.

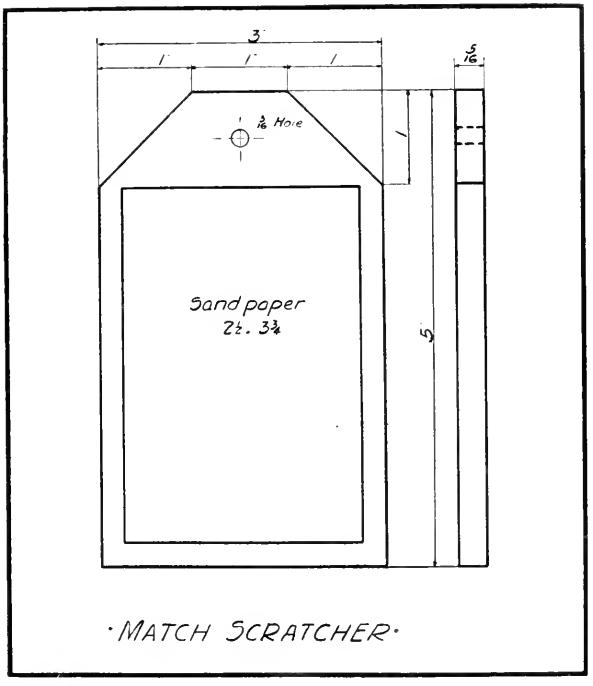


PLATE 2

LESSON NO. 5

MATCH SCRATCHER

Saw off a piece of wood 5¼″ long and 3½″ wide. This allows for planing. In sawing stock a good rule to follow is to allow ¼″ longer and ½″ wider than the required finished size. Plane stock to 5″ long and 3″ wide. Use the first method on page 12; follow carefully the directions, step by step.

Lay out a line 1″ from each edge; also from top. This makes

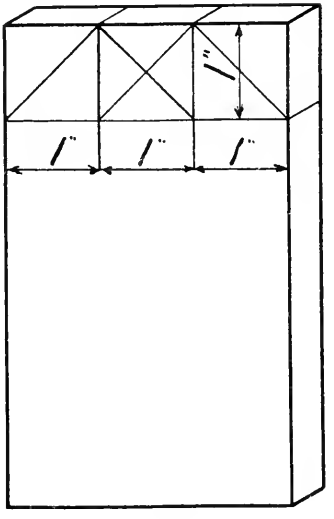


FIG. 26

FIG. 27

FIG. 28

FIG. 29

FIG. 30

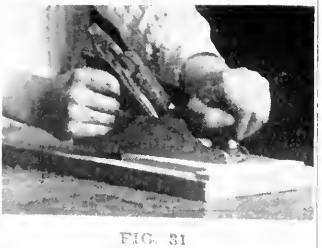


FIG. 31

three one-inch squares at top of board. In the middle square draw diagonals for the location of the hole. In the corner squares draw diagonals for the upper corners, Fig. 26.

Place the board in a vise and saw off corners $\frac{1}{16}$″ from the line with a back saw. Start the saw as if it were a cross-cut or a rip saw. Gradually bring it to a horizontal position so as to cut the full width of the board, Fig. 28.

Plane the corners with a smoothing plane to the lines, not below them, Fig. 29.

Test often with a try square while planing.

Bore hole with $\frac{3}{16}$″ gimlet bit, Fig. 30.

Plane the surfaces clean and smooth. Use a bench-hook to hold the board instead of the vise. Be careful not to plane the board uneven in thickness, Fig. 31.

Sandpaper the edges and surfaces with No. 1 sandpaper wrapped around a block of wood. Hold this against the surface and rub with the grain, never across it, Figs. 32, 33, and 34. Do not round the corners.

Stain and wax. See directions on pages 64 to 67.

Use a piece of No. 1½ sandpaper $2\frac{1}{2}$″x$3\frac{3}{4}$″ for a scratcher and glue it on.

BOARD MEASURE

Quotations on lumber are made at so much per thousand feet board measure, represented by the letter M. A thousand feet board measure equals 1,000 square feet of lumber 1″ or less in thickness. This does not mean that lumber ¼″ in thickness costs the same as lumber 1″ in thickness, but it means that if you bought 1 M of ¼″ lumber you would receive the same surface measurement as if you bought 1 M of 1″ lumber and that this lumber would cover 1,000 square feet of surface if used as a floor. In buying 1 M of 2″ lumber you would receive 500 square feet of surface measurement if used as a floor.

FIG. 32

FIG. 33

FIG. 34

1. How many board feet of lumber are needed to lay a 1″ rough floor in a barn 20′ wide and 50′ long?

Solution: 20×50=1,000.

Ans. 1,000′ board measure or 1,000′ B. M.

2. How many board feet if this floor is 2″ thick?

Solution: 20×50×2=2,000.

Ans. 2,000′ B. M.

3. For a floor 1½″ thick? Solution: 20×50×1½=1,500. Ans. 1,500′ B. M.

4. How many board feet in a board 1″ thick, 1′ 0″ wide, and 10′ 0″ long? Ans. 10′ B. M.

5. How many board feet in a board 1″ thick, 9″ wide, and 16′ 0″ long? Solution: 9/12×16=12. Ans. 12′ B. M.

6. How many board feet in a board 2″ thick, 10″ wide, and 12′ 0″ long?

7. How much would a board 1″ thick, 1′ 0″ wide, and 10′ 0″ long cost with lumber worth $80.00 per M? Ans. $0.80.

8. How much would a board 1″ thick, 18″ wide, and 10′ 0″ long cost with lumber worth $100.00 per M?

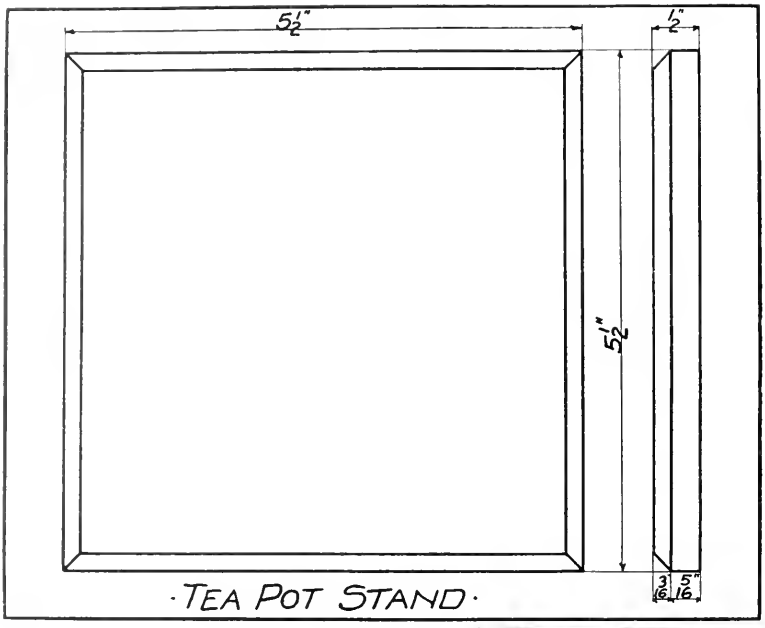


PLATE 3

LESSON NO. 6

TEAPOT STAND

Saw a piece of wood 5¾″ long by 6″ wide.

Plane to 5½″x5½″.

Mark for $\frac{3}{16}$″ chamfer around the top surface of the board with a marking gauge, Figs. 35 and 36.

Plane chamfer, planing the ends first. Use a diagonal stroke so as not to break the edges, Fig. 37, or plane the chamfer, cutting two-thirds across the width of the board and then reverse and plane two-thirds across the other edge.

Plane the surface the same as for the match scratcher, using bench hook.

Sandpaper the same as in the first problem.

Stain and wax. See pages 64 to 67.

FIG. 35

FIG. 36

FIG. 37

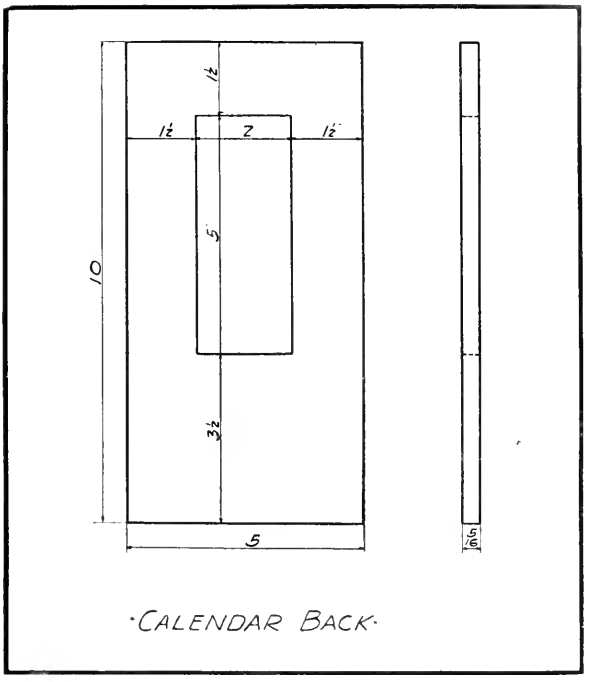


PLATE 4

LESSON NO. 7

CALENDAR BACK

Plane board 10″x5″x⅜″. Mark 1½″ from top and two sides, and 3½″ from the bottom, using the marking gauge, Fig. 38.

Bore $\frac{3}{16}$″ hole at any point in enclosed figure with hand gimlet to put the coping saw through.

Saw out opening with coping saw $\frac{1}{16}$″ inside of lines. Place the coping saw blade through the hole,

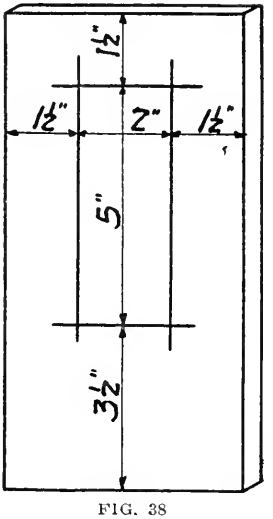


FIG. 38

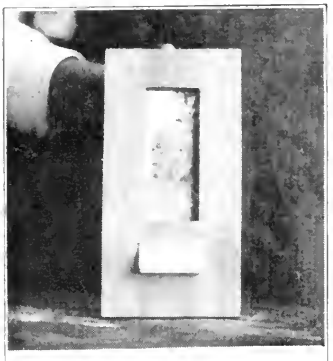


FIG. 39

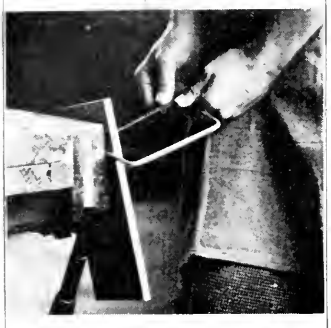


FIG. 40

FIG. 41

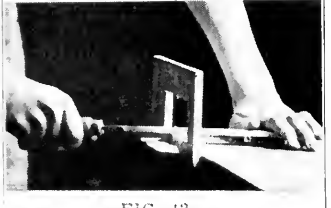


FIG. 42

points of teeth facing away from you. Put the blade in front slot, holding the other end of blade in the other hand with the front end of saw frame against the bench, and press against it until the frame is sprung far enough to receive the other end of the blade, Fig. 40.

Use both hands when sawing and take easy strokes, keeping the blade perpendicular at all times to the board, Fig. 41. In turning corners do so very slowly. In taking saw apart use same method as in putting it together.

File to lines, using a flat file. Place both hands on file, Fig. 42, and keep horizontal so that the filed edge will be perpendicular to the board. In filing, the stroke is forward and sideways at the same time, so that the cut will be continuous along the whole length of the edge. The file cuts on the forward and not the backward stroke.

Plane clean, sandpaper, stain, and wax.

Glue picture to the back and cover with a piece of straw board.

Tack calendar to back with brass tacks or use $\frac{3}{8}''$ round-head screws.

Suggestion.—Select a calendar and picture with colors and design in harmony with wood used.

LESSON NO. 8

TRELLIS

Stock, finished size.

1 piece ¼″x1¾″x2′0″.
1 piece ¼″x ½″x 9″.
1 piece ¼″x ½″x 6″.
1 piece ¼″x ½″x 3″.

Lay out as shown on your drawing for location of holes, rip sawing, and pointing of bottom, with try square and marking gauge, Fig. 43.

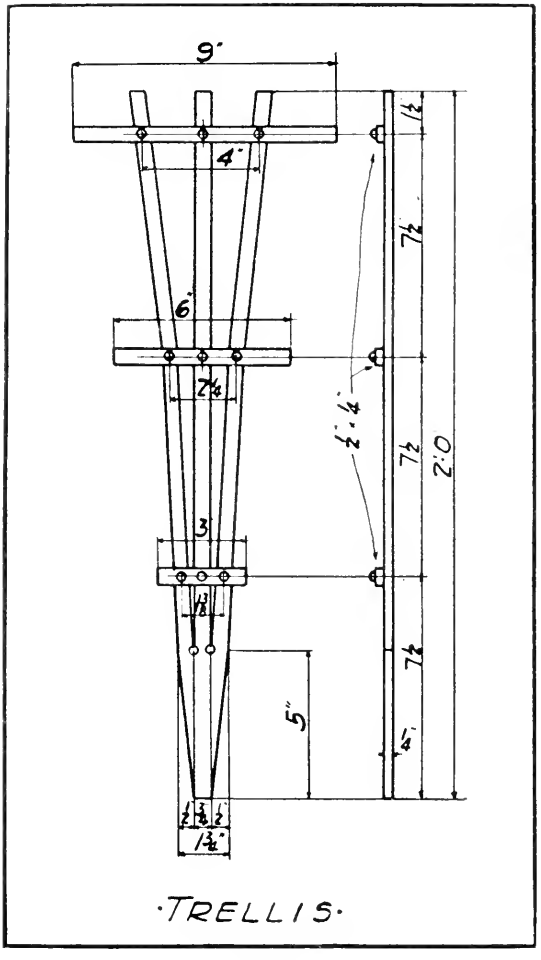


PLATE 5

FIG. 43

FIG. 44

FIG. 45

FIG. 46

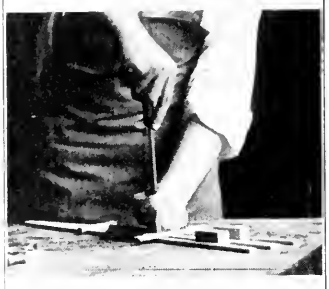


FIG. 47

Bore with $\frac{5}{16}$″ dowel bit. Place the bit in the brace and be sure to get the jaws of the brace to fit around the square shank of the bit. Bore the holes, putting the board in a vise, Fig. 45. Hold the brace and bit perpendicular to the surface of the board and bore until tip of bit just comes through other side of board. Then turn the board around and bore from the other side. This will leave a clean cut hole from both sides, instead of a ragged one on one side, as is the case when the hole is bored through from one side only.

With a rip saw, cut on marking gauge lines, Fig. 46. Clean all pieces with a plane. No sandpapering is necessary.

Assemble parts, using two $\frac{7}{8}$″ blocks of wood to spread the arms, Fig. 47. Be careful not to spread them too far and thus split the wood. $\frac{3}{8}$″ No. 3 round-head screws will make very nice work, although $\frac{3}{8}$″ brads may be used.

Give one coat of green paint to protect the wood from moisture and harmonize it with the foliage of the plant the trellis is to be used with.

Suggestion.—By increasing or decreasing the thickness of the lumber and the width of the stock a trellis of any desired size may be constructed.

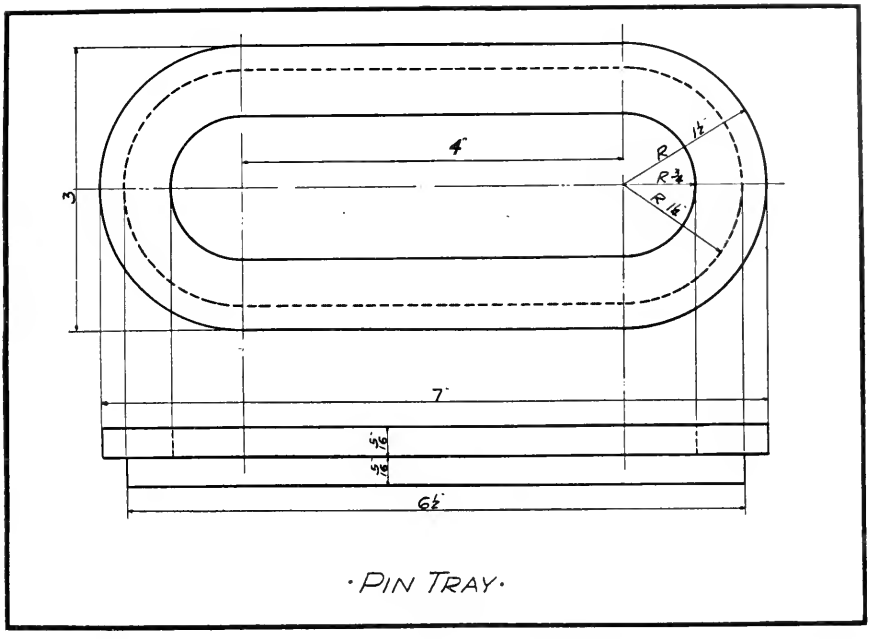


PLATE 6

LESSON NO. 9

PIN TRAY

Cut a piece of stock 7½″ long, 6½″ wide, and ⅜″ thick. With rip saw cut this board into two pieces; one 7½″ long by 3½″ wide, the other 7½″ long by 3″ wide.

Lay out with dividers and try square as shown in Fig. 49. Fig. 50 is a photograph of the board properly laid out.

Plane to the lines of both boards. Keep the edges of both boards straight and square with the concave face of each. There will then be two boards, one 7½″ by 3″ and

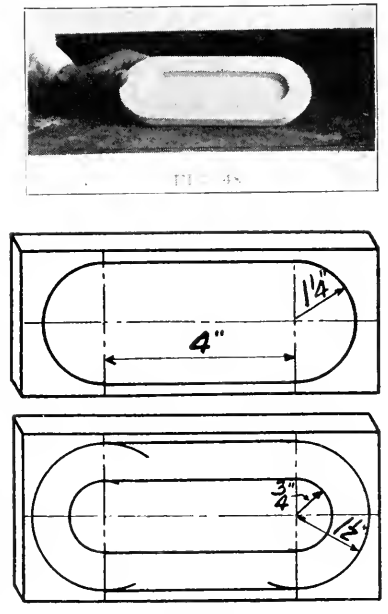


FIG. 49

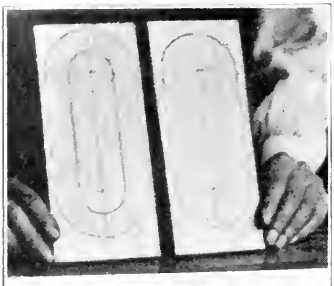


FIG. 50

FIG. 51

FIG. 52

FIG. 53

FIG. 54

the other 7½″ by 2½″. Their long narrow edges will be parallel and square with the concave face of both boards.

Saw ends of both boards $\frac{1}{16}$″ away from lines. Use coping saw.

In the larger board saw out the enclosed space in the center. Use coping saw.

Now file this inner opening with the half round file. Then file the ends with the flat side of the file following the lines of the curve. Do not file across the width of the board, Fig. 51.

Plane all the surfaces of both boards clean and smooth.

Sandpaper the opening, putting the sandpaper around a half round file, Fig. 52.

Sandpaper the curved ends by rubbing them over sandpaper held upon the bench. Use a rocking motion, Fig. 53. Sandpaper the remaining edges and surface in the usual way.

Nail the two pieces together with ½″ brads, Fig. 54.

Set the nails $\frac{1}{16}$″ below the surface, using nail set. Avoid striking the wood with the hammer.

With No. ½ sandpaper carefully smooth the whole problem.

Stain and wax.

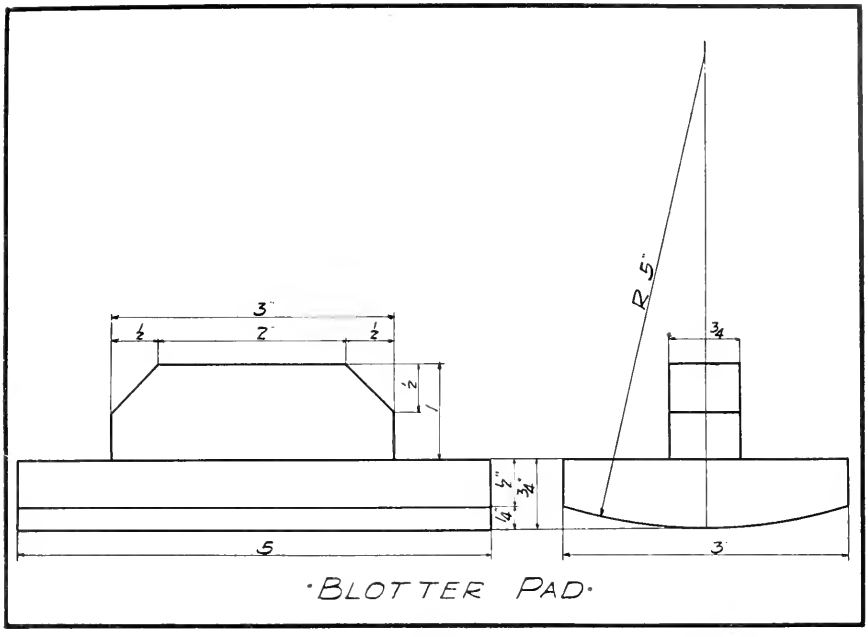


PLATE 7

LESSON NO. 10

BLOTTER PAD

FIG. 55

Stock, finished size.

1 piece ¾″x3″x5″.
1 piece ¾″x1″x3″.

With marking gauge lay out a line ¼″ from the bottom along the two long edges, Fig. 56.

Place in a vise, Fig. 57, with a block of wood about 6″ long, the bottom side of the blotter pad facing away from the block.

Set the dividers at 5″, placing one leg of the dividers at one of

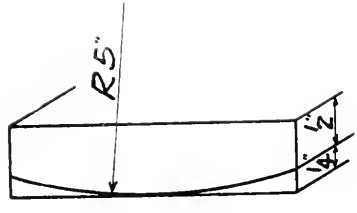


FIG. 56

FIG. 57

FIG. 58

FIG. 59

FIG. 60

the ¼″ lines and strike an arc. Do the same from the other ¼″ line, Fig. 57. At the intersection of these arcs place one leg of the dividers and draw the bottom curve, Fig. 58. On the other end do the same.

Place in a vise and plane to curve, Fig. 59. Sandpaper the bottom, going across the grain, so as to smooth out the flat sides left by the plane, Fig. 60.

Shape handle. See Problem No. 1.

Nail together with 1½″ nails.

Finish.

Glue blotter to bottom.

SUMMARY.—These ten lessons have illustrated the use of rip and cross cut saws, the laying out and sawing of boards; the use of the try square; the use and adjustment of the plane; the four methods of squaring a board; the use of the back-saw; the trueing of edges at any angle; the use of a hand gimlet bit; the use of sandpaper; the cutting of a chamfer; the use of coping saw and file; the use of brace and bit; interior cutting; the use of screws and nails; the assembling of the parts of a project.

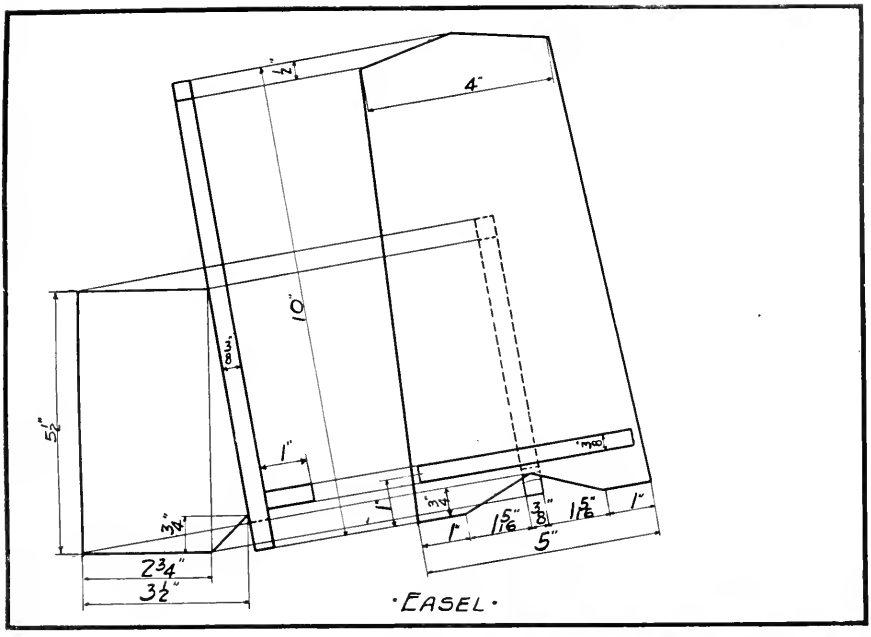


PLATE 8

FIG. 61

LESSON NO. 11

PICTURE EASEL

Stock, finished size.

No. 1. 1 piece ⅜″x5″x10″.
No. 2. 1 piece ⅜″x3½″x5½″.
No. 3. 1 piece ⅜″x1″x4½″

On piece No. 1, plane the work-edge and one end. Square the end with the working edge. Use this end for the bottom. Lay out design as shown on your drawing, Fig. 62. Cut design with back saw, Figs. 64 and 65, and plane true.

On piece No. 2, plane the working edge and both ends. Square the ends with the working edge. Lay out as shown on drawing, Fig. 63.

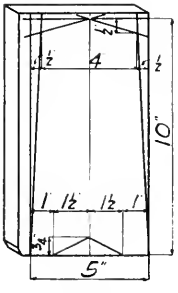


FIG. 62

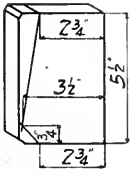


FIG. 63

FIG. 64

FIG. 65

FIG. 66

FIG. 67

FIG. 68

On piece No. 3, true all edges.

Take a fine cut off all surfaces of the three boards with a smoothing plane. This will make them smooth and clean. Then sandpaper.

After sandpapering, lay out the following light lines with a sharp pencil on piece No. 1; a center line from top to bottom on both sides of board; a horizontal line 1″ from the bottom on both sides of board. The center line is for nailing No. 1 on No. 2. The bottom line for nailing No. 1 on No. 3.

Decide which is to be used for the back of piece No. 1, preferably the convex side. (It makes a better joint to place the concave side against the piece it is to be nailed to.) Drive four 1″ No. 17 brads into the board on the bottom line, so that the points of the nails come through. If the nails have been driven in correctly the points will pass through the lines on the other side of the board.

Place piece No. 3 in position, Fig. 66, and continue driving the nails. Set the nails with a nail set. Be careful not to mar the board. The hammer should not touch it.

Place piece No. 1 against piece No. 2 as it will stand when finished, Fig. 67, and mark where it belongs. Drive four 1″ No. 17 brads through the center line as you did for the first piece. Put piece No. 2 in place, Fig. 68, and finish. Rub all pencil lines off with a rubber eraser and sandpaper where needed.

Use the finish you prefer.

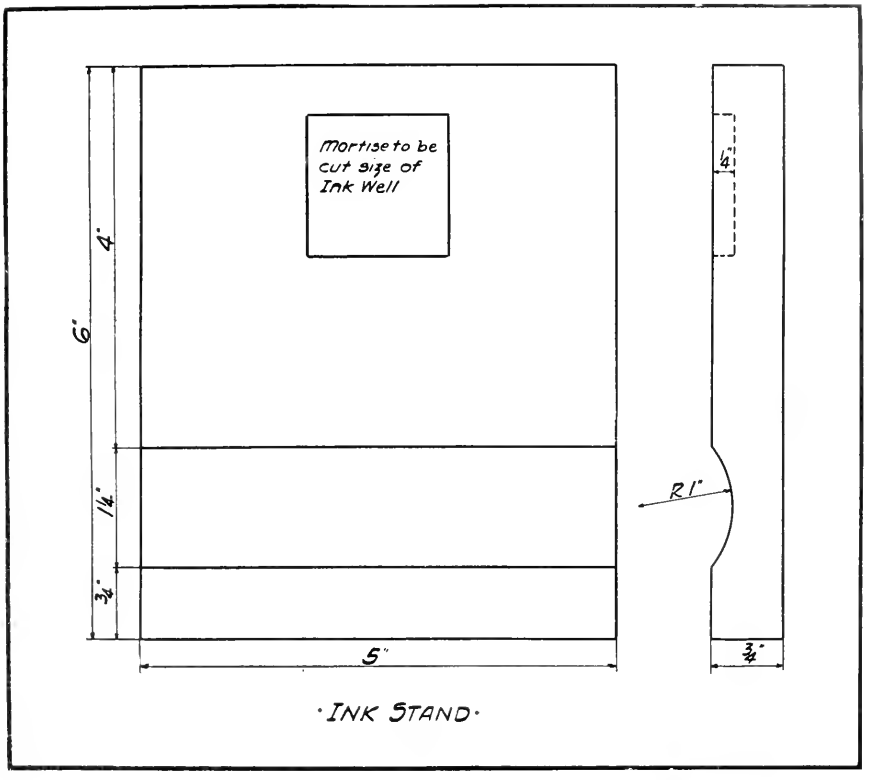


PLATE 9

LESSON NO. 12

INK STAND

Stock, finished size.

1 piece 5″ long, 6″ wide, ¾″ thick.

True all edges.

Lay out for groove and mortise, with marking gauge, dividers, try square and a pencil, Figs. 70 and 71. See Lesson 10 for method of laying out groove with dividers.

Sharpen gouge with a regular oil stone, Fig. 72, and slip stone, Fig. 73. Use the regular oil stone

FIG. 69

FIG. 70

FIG. 71

FIG. 72

FIG. 73

FIG. 74

to raise the feather edge which will lie on the inside of the curve, Fig. 72. Then alternate with the slip stone on the inner curve, Fig. 73, and the oil stone on the outer curve until the feather edge disappears. The slip stone is made of the same material as the oil stone, the difference being in shape only.

With a rubber mallet and a gouge cut the groove close to the lines, Fig. 74.

Then finish without the rubber mallet, holding the gouge in both hands and carefully paring to the lines, Fig. 75. Leave no large ridges.

Scrape with a goose-neck scraper all the ridges out of the groove, Fig. 76.

Sandpaper the groove by wrapping sandpaper around a cylinder 1½″ in diameter, Fig. 77, or make a block about 5″x1½″ with an edge curved to a ¾″ radius. Use the method followed in Lesson 10 in making this block. The cylinder or block should always have a smaller radius than the groove.

Cut the mortise. Sharpen the chisel as the plane iron was sharpened with the exception that the edge of the chisel is kept straight instead of being slightly curved.

Place the chisel on the line, with the straight side facing the out-

side of the mortise. With a rubber mallet cut about $\frac{1}{16}$″ deep all around the mortise, Fig. 78. Then put the board in a vise and cut down $\frac{1}{16}$″, chiseling across the grain of the wood, Fig. 79. Repeat this operation until the mortise is about $\frac{1}{4}$″ deep.

Plane clean and smooth, and sandpaper. Finish in any manner desired.

FIG. 75

FIG. 76

FIG. 77

FIG. 78

FIG. 79

EXERCISES

1. Tell how you would make a blotter pad without using a handle but in place of it gouging out the sides for finger grips.

2. Tell how you could make a pin tray out of a single block of wood by using the gouge.

3. Make a drawing for an ink stand for two bottles of ink; one red and the other black.

4. Tell how to grind a gouge.

5. Tell how to oil stone a gouge.

6. Tell how to grind a chisel.

7. Tell how to oil stone a chisel.

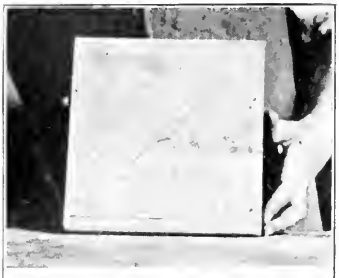


FIG. 80

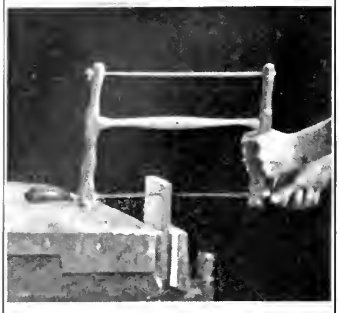


FIG. 81

FIG. 82

FIG. 83

SHELF—FREEHAND ORNAMENTAL DESIGN

Stock, finished size.

Top, 1 piece 5/8″x8″x12″.
Back, 1 piece 5/8″x7½″x8″.
Bracket, 1 piece 5/8″x7″x7″.

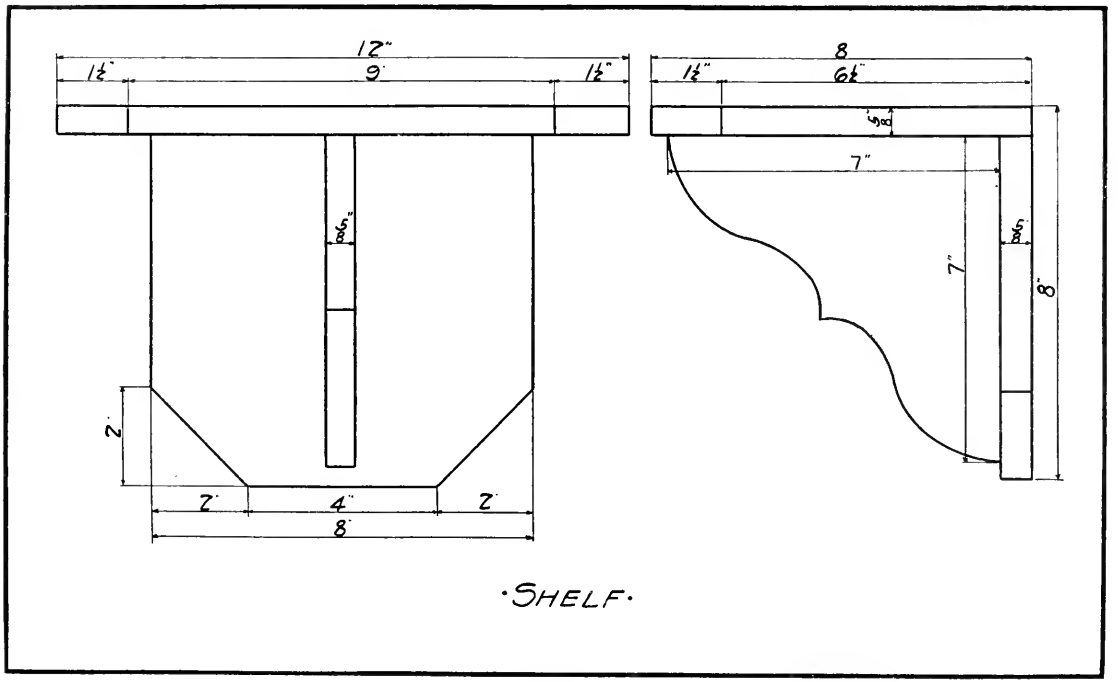
True the top and cut the corners.

True the back and cut the corners.

True one edge and one end of bracket. On this trued edge and end mark off the length and width of the bracket. The design when finished will be drawn diagonally on this piece. Make a freehand design on thick paper. Cut it out with a knife and use it as a pattern by placing it on the board and pencil around the pattern. Fig. 80 is a photograph of the lay out of the bracket.

With a turning saw cut $\frac{1}{16}$″ away from the line, Fig. 81. File to the line with a half round file. The curve when completed should be continuous, that is, should have no flat places. Plane and sandpaper all pieces.

In the back piece draw a center line from top to bottom on both sides. Do the same with the top. Now the problem is ready to be assembled.



·SHELF·

PLATE 10

FIG. 84

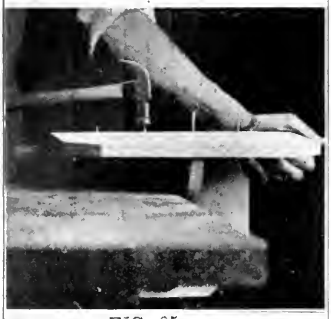


FIG. 85

FIG. 86

FIG. 87

Drive five nails at reasonable spaces apart into the back along the center line so that the points come through slightly on the other center line. Place bracket in a vise, Fig. 82. Drive nails in the back. Remove from vise and test for accuracy. Return to vise and complete the nailing. Plane both absolutely true, Fig. 83.

In the top piece, with marking gauge, draw a line 5/16″ parallel with its back edge. This is the nailing line for the top to the back. Put 5 nails along the center line and 4 nails along the back line. Place the bracket and back in the vise and nail the top to the bracket, testing as before, Fig. 84. To nail the top to the back place in the vise so that the nails will not be driven into the overhanging end, Figs. 85 and 86.

Set all nails $\frac{1}{16}$″ below the surface with a nail set.

Plane back smooth, and true if necessary, Fig. 87.

Erase pencil lines or plane them out. Then sandpaper and finish as desired.

NOTE.—This shelf may be adapted to any desired position or material. Plan a shelf for the kitchen at your home.

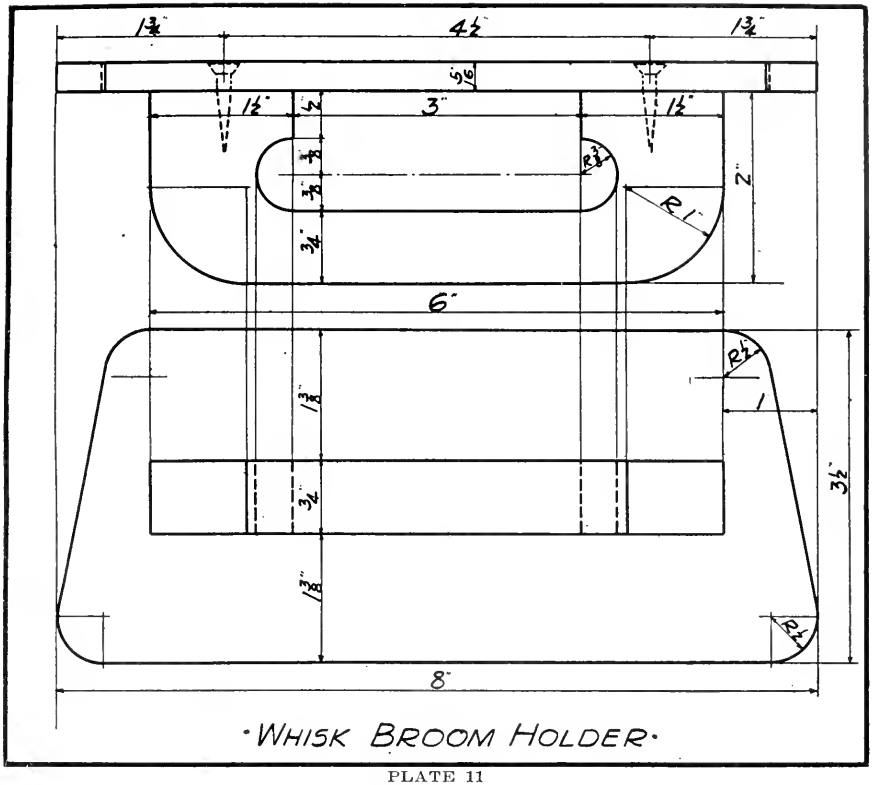


PLATE 11

LESSON NO. 14

WHISK BROOM HOLDER

Stock, finished size.

Front, 1 piece ¾″x2″x6″.
Back, 1 piece ⅜″x3½″x8″.

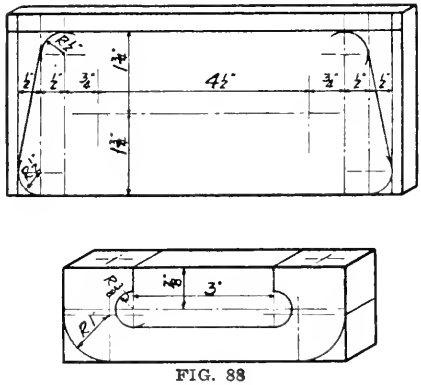


FIG. 88

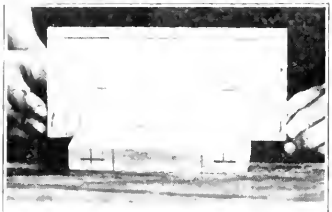


FIG. 89

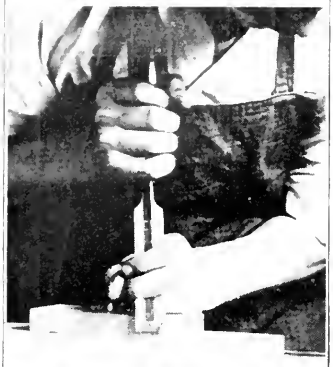


FIG. 90

FIG. 91

FIG. 92

True the front piece, all four edges.

True only the working edge of the back piece.

Lay out front piece as shown in Fig. 88, lower. Fig. 89, lower, shows the front piece laid out with reference to the centers of the holes to be bored and the corners to be cut. It is not necessary to lay out the ¾″ semi-circles because when the centers are laid out, the tip of the bit is placed at these centers and the holes bored. The centers for holes for the screws may be laid out from the first.

Lay out the back piece as shown in Fig. 88, upper, using the working edge, which is already trued, to work from. Use a try square, a marking gauge and dividers to draw all lines. Fig. 89, upper, is a picture of the complete lay out.

Chisel the corners of the front piece using a 1″ chisel. Sharpen the chisel first, as a dull chisel tears. Take a cut about ⅛″ wide starting on the edge with the grain and cutting across the thickness of the board, Fig. 90.

Place the piece on the benchhook or on a scrap piece of wood to protect the bench. Continue taking ⅛″ cuts, Fig. 91, until the curve is completed.

Bore two holes with a ¾″ dowel bit, being sure to turn the board over and bore from the other side

when the tip of the bit comes through. The holes show in Fig. 92.

With a back saw cut as shown in Fig. 92, keeping at least 1/32″ away from the line in order to smooth up later. Cut out the remainder with a turning saw or use small cuts and chisel it out. When close to the line pare as shown in Fig. 93. The stroke is somewhat of a saw stroke, being from side to side, as well as forward. The cut must be very fine. The ends may be chiseled in the same way, Fig. 94. Great care must be taken here not to split the edges. These ends may be carefully filed instead of being chiseled.

With a rip saw and a back saw cut the back piece $\frac{1}{16}$″ away from the line and plane to lines square with the concave surface. Chisel the corners as in the first piece. Complete with a file. Use the file as in the previous problem.

File the corners of the front piece in the same manner; also with the half round file smooth the inside of it.

Bore the holes for the screws and countersink, Fig. 95.

Plane the board clean with a smoothing plane and carefully sandpaper. For the inside of the front piece wrap sandpaper around the file. Put together with flat-head screws, Fig. 96.

Stain and wax.

FIG. 93

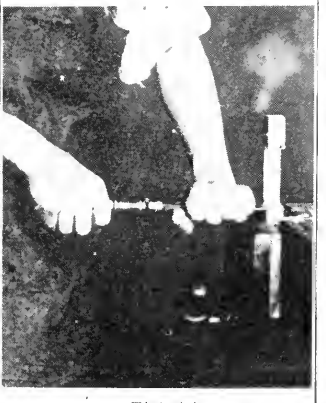


FIG. 94

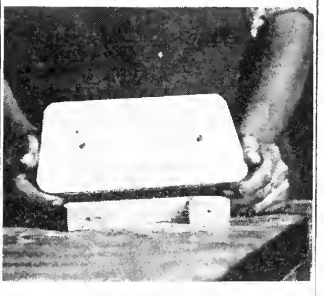


FIG. 95

FIG. 96

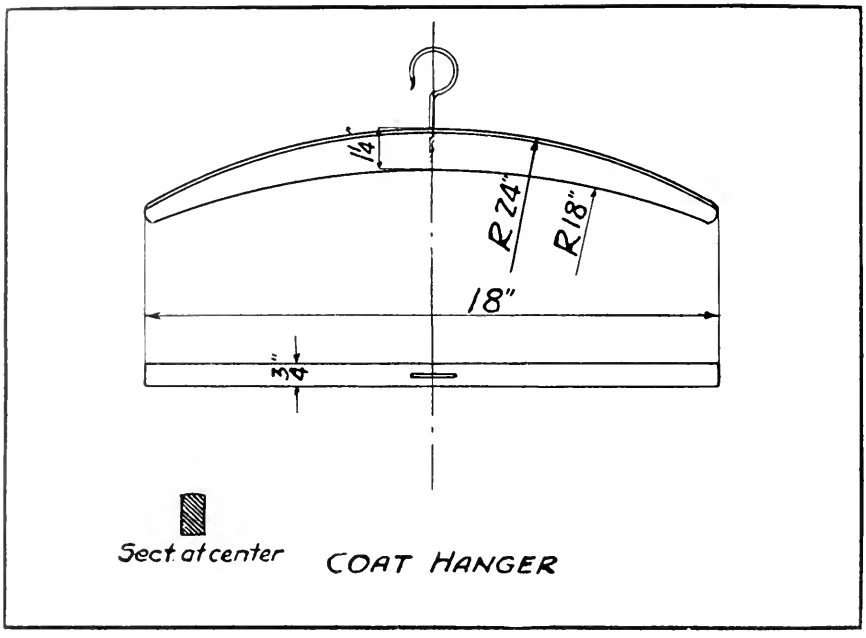
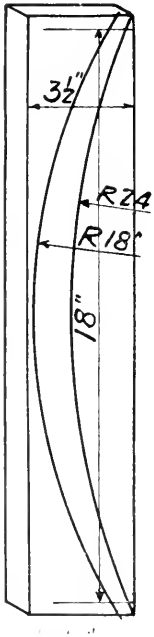


PLATE 12



LESSON NO. 15

COAT HANGER

Stock.

1 piece 18½"x3½"x¾".

Lay out as shown in Fig. 97.

With a turning saw cut $\frac{1}{16}$" away from the lines. Keep the saw perpendicular to the board and be sure it is not twisted, that is, the handles should be turned exactly alike at all times in their position. Use both hands on the saw frame and use easy strokes as the saw blades are easily broken, especially the narrow ones.

Trim to lines using spoke shave. The blade of spoke shave is sharpened in the same manner as the blade of a plane and cuts much the

same. It will be found better to push the spoke shave away from you in doing most work, though sometimes it will be easier to pull it toward you. The bottom edge of the coat hanger should be cut flat and square with the side. The spoke shave is held perpendicular to the side, Fig. 98. In cutting, cut from the end of the board to the middle and then reverse the board and cut from the other end so as not to cut against the grain of the wood.

Cut the top edge in the same manner, Fig. 99, and when it is cut to the line round it a little by turning the spoke shave, Fig. 100. When finished round the end of the piece with a chisel. See Figs. 90 and 91 in previous problem.

Plane clean with a smoothing plane. It will be necessary because of the irregular shape to nail extra blocks on the bench hook to hold it. Be sure to remove these blocks later.

Sandpaper the problem. The bottom and sides are sandpapered in the usual manner. For the top edge take a half sheet of sandpaper and hold it at both ends, and pull it up and down as if polishing a shoe with a cloth, Fig. 101. This will rub off the ridges left by the spoke shave. The blade of the spoke shave being flat makes the top edge many sided instead of round.

Put the hook in the center.

Give two coats of shellac.

FIG. 98

FIG. 99

FIG. 100

FIG. 101

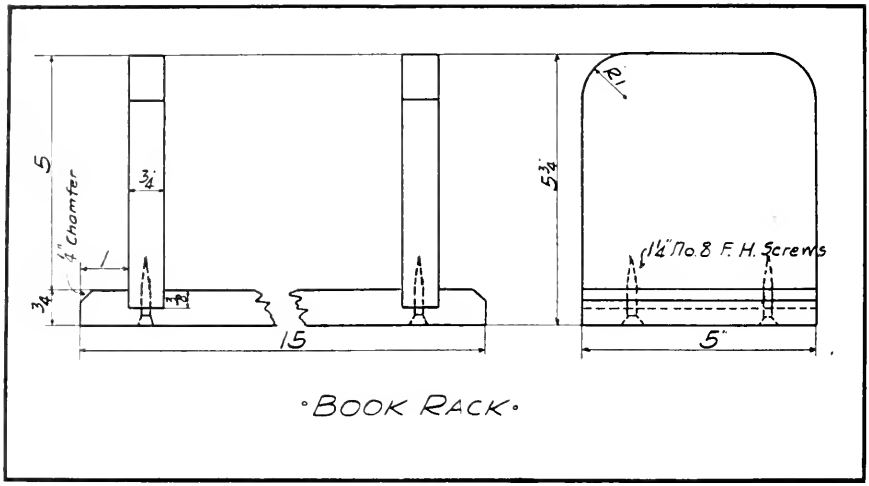


PLATE 13

FIG. 102

FIG. 103

LESSON NO. 16

BOOK RACK

So far all our joints have been butt joints, that is, simply one board against the other. In some articles this joint is not as strong as necessary and to secure the additional strength one piece is inserted in the other. There are many ways of doing this. The simplest is the grooved joint used in the book rack. In this problem the joint is reinforced by means of screws, though it would in all probability be strong enough with glue only.

Lay out with the try square, knife, Fig. 103, and marking gauge, at both ends as shown in Fig. 102, to the depth of the groove. Saw as close to the lines as possible, but be careful to keep within the lines.

Cut out between the saw lines with a chisel and rubber mallet, cutting half way across and then reversing the board and cutting the other half, Fig. 104. If necessary trim with a chisel and rubber mallet, Fig. 105. Keep the chisel perpendicular to the face of the board and watch the lines closely, as a groove that is too wide is worthless.

If groove is not deep enough use the chisel at a slight angle as you would a knife, Fig. 106.

If the ends are too thick plane them to the width of the groove; clean all surfaces with a plane and sandpaper.

Assemble, using glue and screws. Be sure to test with a try square so that the ends will be perpendicular to the bottom.

Plane the edge after the assembling, Fig. 107, to take off any unevenness that may be present.

Sandpaper where necessary. Do not forget the block of wood when sandpapering.

Let the glue dry at least twenty-four hours.

Stain and wax.

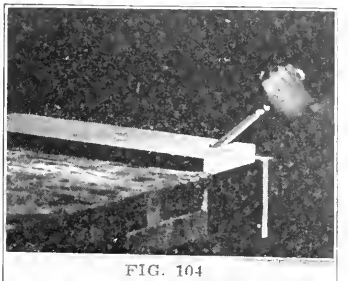


FIG. 104

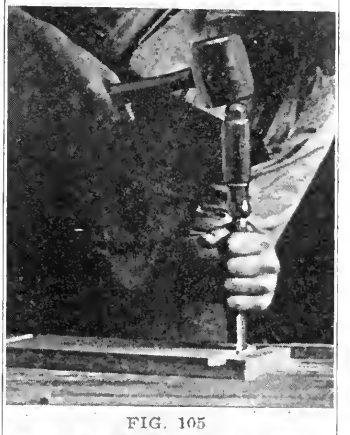


FIG. 105

FIG. 106

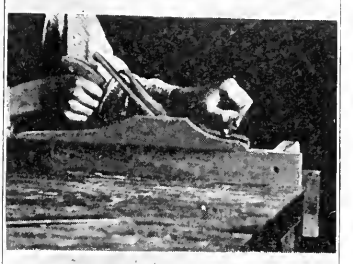


FIG. 107

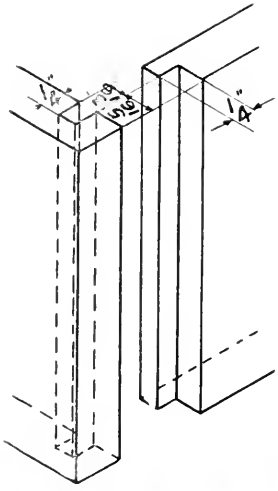


FIG. 108

FIG. 109

FIG. 110

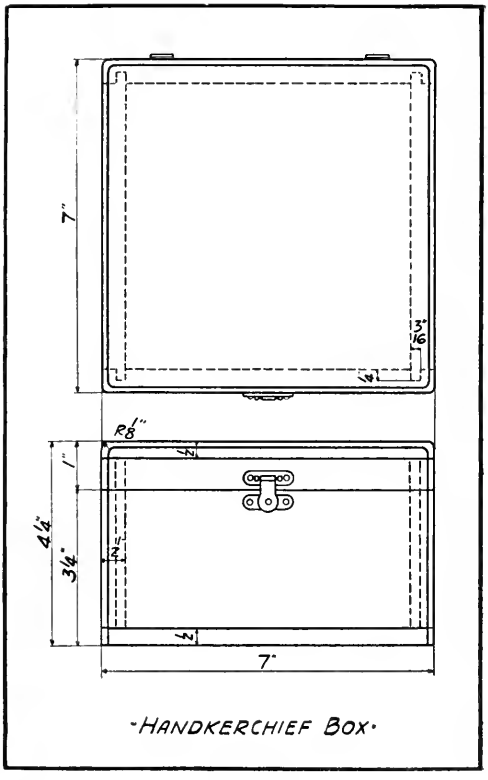


PLATE 14

LESSON NO. 17

HANDKERCHIEF BOX

Consult the drawing for dimensions of pieces, Plate 14.

True both edges and ends. Lay out the tongue and groove, Fig. 108, using knife, try square, and marking gauge. Mark all cross lines, Fig. 109, with a knife and try square. Mark depth of tongue with a marking gauge and cut out. Lay out and cut the groove in the same

manner. Plane smooth the surfaces to be used for the inside of the box.

Test the parts by putting them together with hand screws. The jaws of the screws must be parallel when tightened. Take apart by loosening the screw in the end of the jaw; do not touch the middle screw. Give each surface of the joint a thin coat of glue and clamp the parts together, tightening the screw in the end of the jaw only. This pressure forces out all surplus glue and also forces the glue into the pores of the wood, thus doing the work of numerous small nails, Fig. 110.

Plane the top and bottom edges flat, Fig. 111. Now the box is ready for the top and bottom.

Make top and bottom pieces each $\frac{1}{8}''$ larger than the space to be covered. Glue them in place, Fig. 112. The slight projection is to be planed off later when the glue dries, Fig. 113. Plane the whole box smooth. Round the corners to the radius in the drawing. The box is now ready to have the lid sawed off. With a marking gauge draw a horizontal line $1\frac{1}{16}''$ from the top of the box on the four sides, Fig. 114. On this line, with rip saw, cut off the lid, Fig. 115. Plane these edges smooth. Stain, shellac, and wax the box inside and out. Place hinges and clasp when the box is thoroughly dry.

FIG. 111

FIG. 112

FIG. 113

FIG. 114

FIG. 115

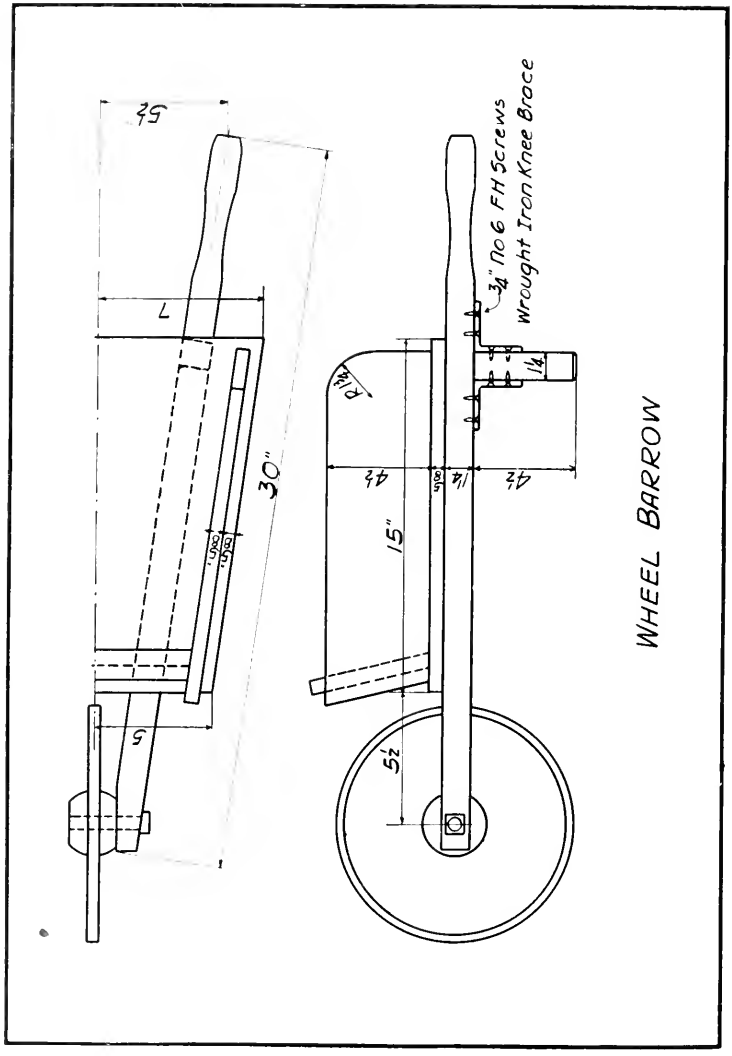

WHEEL BARROW
3" No 6 FH Screws
Wrought Iron Knee Brace
30"
15"
7
5
4½
1¼
¾
1½
2½

PLATE 15

LESSON NO. 18

A CHILD'S WHEELBARROW

Before starting the construction of this problem carefully study the working drawing. Make out a stock bill on a form similar to the one shown in Fig. 116. Have this stock bill passed upon by your instructor.

STOCK BILL (Finished Size)					
No of Pcs	Thickn's	Width	Length	Description	Mark

FIG. 116

Cut your stock, using the bill for sizes, allowing enough extra length and width for planing and sawing.

True all pieces to finished size as shown on your stock bill.

The handles are shaped with a spoke shave, Fig. 117, and finished by rubbing them with a strip of sandpaper, in a manner similar to that used in polishing a shoe with a cloth, Fig. 118.

Fit the wheel and axle to the handles. This requires careful fitting. Put the box together with nails or screws. Nail the box to the handles, having the wheel, axle and handles assembled at the time the nailing is done.

Secure four wrought iron braces and fasten the legs to the handles with them, using $\frac{3}{4}$″ No. 6 screws.

Finish as desired.

FIG. 117

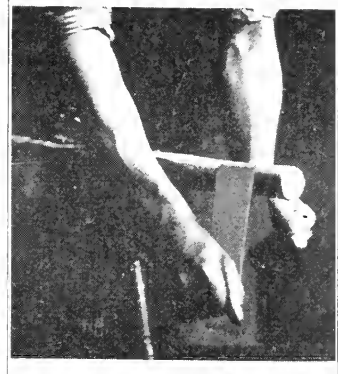


FIG. 118

LESSON NO. 19

HAT AND COAT RACK

Carefully make a stock bill on form similar to one shown in Fig. 116. True pieces to correct sizes and shapes.

Lay out the holes for the dowels. With marking gauge draw a center on the inner edge of each of the vertical pieces and also on the ends of the horizontal pieces. Place the two vertical pieces together and with a try square draw lines across

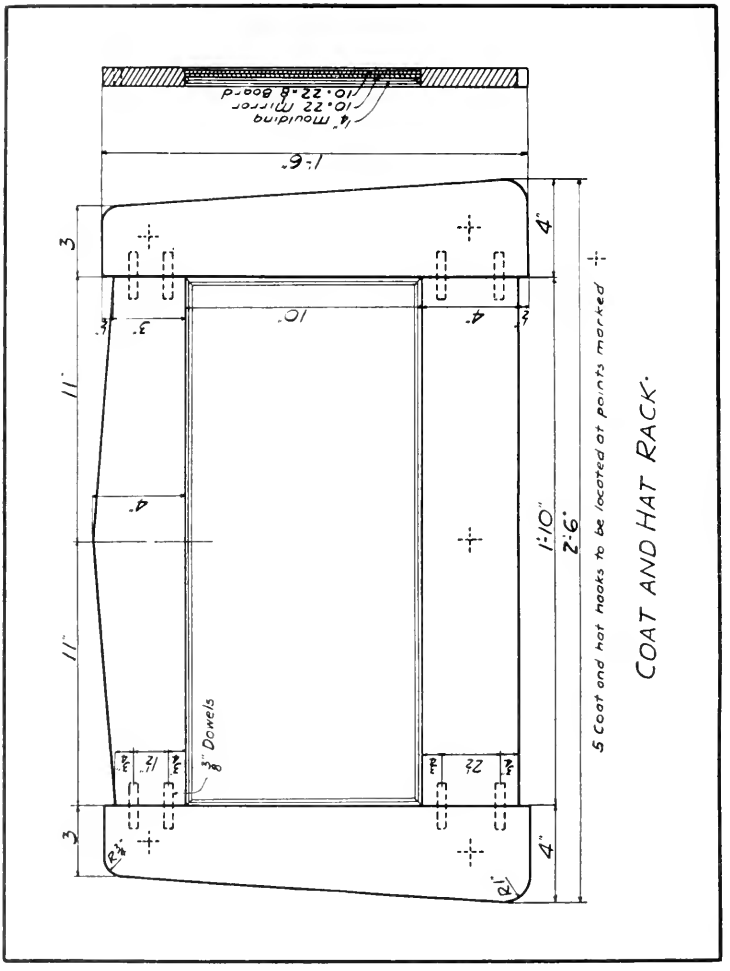


PLATE 16

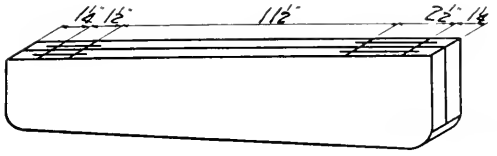


FIG. 119

at the proper distances, Fig. 119. With the horizontal pieces the marking gauge may be used for both the center lines and the cross lines. Care should be taken to mark from the same edge for all the holes in each piece. Before boring the holes test by placing the pieces together in their respective positions; see if the lines coincide. Bore ⅜″ holes 1¼″ deep, being sure to have them perpendicular to the plane in which they are bored.

Cut enough dowel pins 2¼″ long to put the problem together. Point the ends about $\frac{1}{16}$″ with a dowel pointer or a knife.

Put the problem together with clamps, without glue. If correct after testing, take apart, put glue on the dowels, Fig. 120, in the dowel holes, and on both surfaces of the pieces, Fig. 121. Clamp together, Fig. 123, and allow twenty-four hours to dry.

Plane surfaces smooth and clean. Scrape with a cabinet square scraper, Fig. 124.

Fit ¼″ molding for the mirror. In cutting the miters use tee bevel for marking and testing. Set bevel at 45°. Cut the back from ⅛″ or $\frac{3}{16}$″ stock.

Finish as desired.

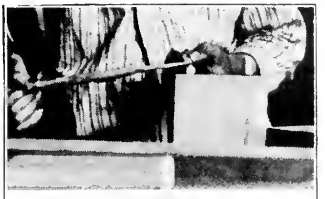


FIG. 120

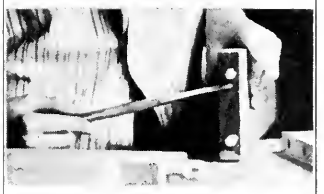


FIG. 121

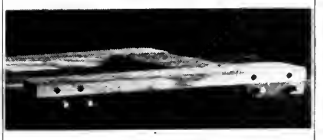


FIG. 122

FIG. 123

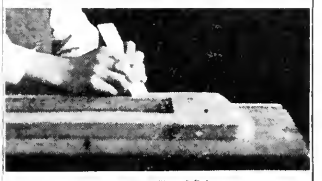


FIG. 124

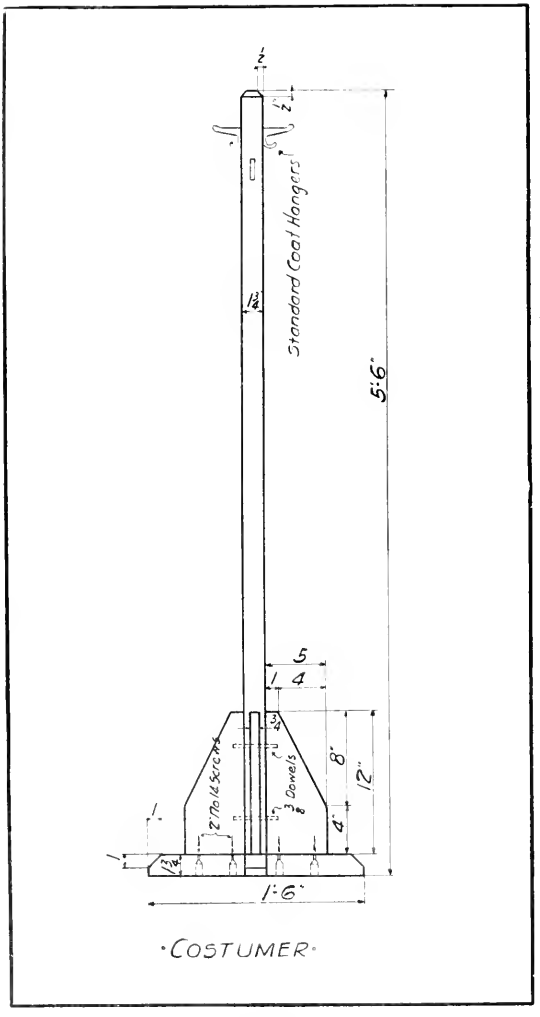

Standard Coat Hangers
5'-6"
1½"
5
1 4
8"
12"
4"
2 No. 14 Screws
⅜ Dowels
1'-6"
COSTUMER

PLATE 17

LESSON NO. 20

A COSTUMER

The making of a half lap joint is the new exercise taken up in this problem. Square the two pieces for the base 18″ by 1¾″ by 1¾″, and make sure that they are exactly alike. Then with knife, try square, and marking gauge lay out the grooves, which must be exactly in the center of the pieces, of the same width of a piece, and one-half the thickness, so that they will fit into each other.

With back saw cut close to the lines, Fig. 125. With chisel and mallet cut out the piece between the saw kerfs, Fig. 126. Cut from both sides so as not to break the edges. Carefully trim the bottom of grooves with a sharp chisel, Fig. 127. If the grooves are not quite wide enough or deep enough pare carefully with chisel to proper size, Fig. 128.

Put together with glue and clamp. Allow twenty-four hours to dry. Scrape off any surplus glue, and plane top and bottom surfaces flat.

Shape and true all the other pieces.

Assemble problem.

From the large variety of hat and coat hooks obtainable, choose the ones best adapted to the harmony of the problem. Be simple rather than ornate.

FIG. 125

FIG. 126

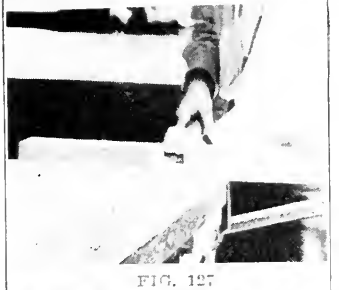


FIG. 127

FIG. 128

LESSON NO. 21

A TABOURET

The new problem involved in this project is to glue two boards together to make a board wide enough for the top. Every other feature of the construction of a tabouret has been worked out in some previous problem.

Decide the particular kind of tabouret to be made. See illustrations on page 61. Then shape all the required material.

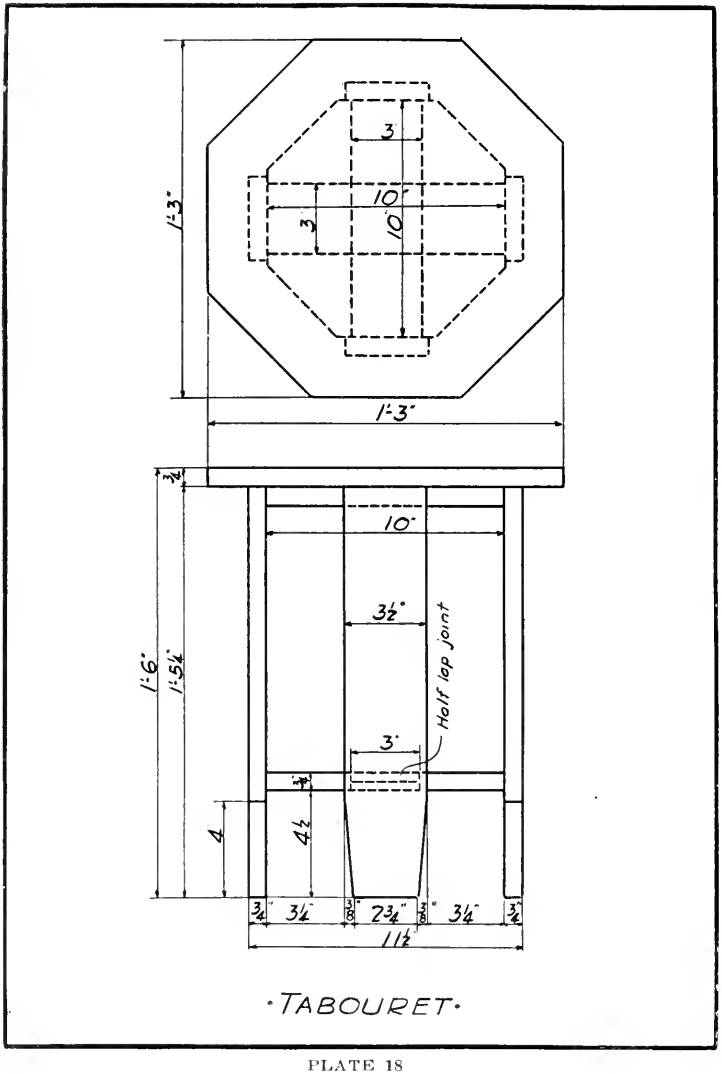


PLATE 18

In preparing the top select two boards whose combined width will be at least 1″ more than the width, and 1″ more than the length.

Note the grains of the two pieces; see that they are alike in direction. Test this by planing off a shaving in each. Mark the direction of the grain with a pencil.

True the two edges to be glued.

Make them slightly concave from end to end, about 1/100″. This is to avoid possible end cracking due to shrinkage. Place the two edges together and draw a thin piece of paper through the space. If the paper does not bind the space is accurate, Fig. 129.

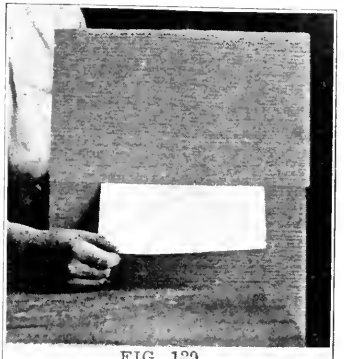


FIG. 129

These two edges are dowelled together. Care must be taken that the dowel holes in both boards exactly agree. There are two methods by which this may be done. Here is one of them—On one of the edges drive in three brads, one in the middle, and one 3″ from each end. With the cutting pliers or file, cut off the heads of the brads. Place the other edge exactly in position over these brads and tap the board with the hammer so that the brad makes a mark. Draw out the three brads. In the six marked places bore the dowel holes. The other method is to draw a center line with the marking gauge in each edge; then place the boards together and with a try square, draw three lines across both edges, one in the middle, and one 3″ from each end, Fig. 130.

FIG. 130

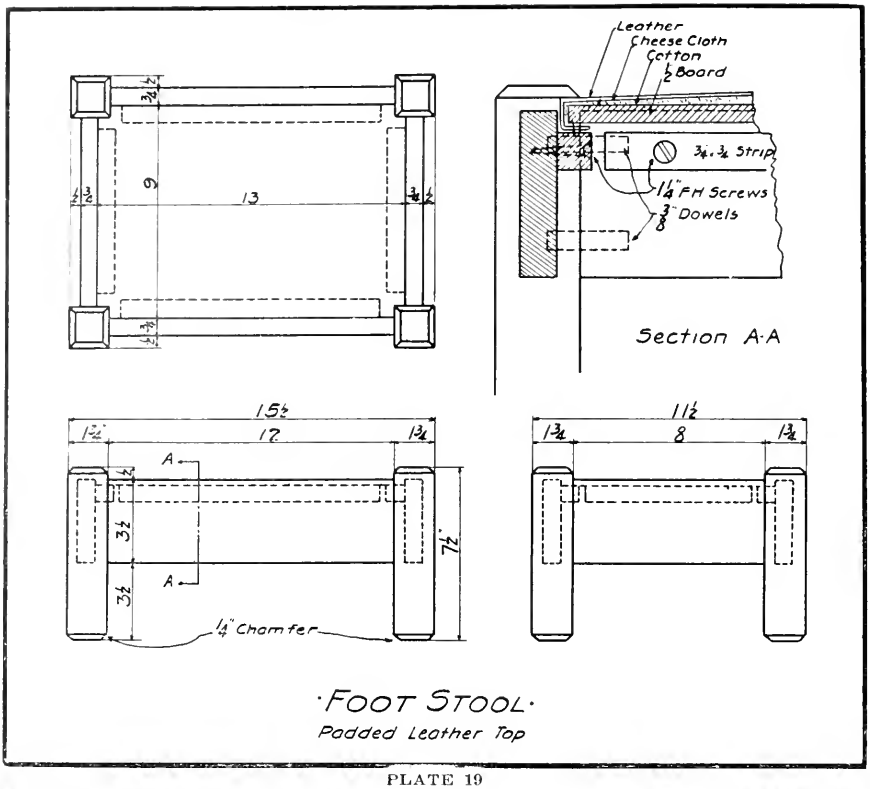
Put dowel pins in place.

Clamp boards together, using handscrews to prevent bulging, Fig. 131. Separate, and if correct in every particular, glue.

FIG. 131

Clamp together again and let glue set for twenty-four hours.

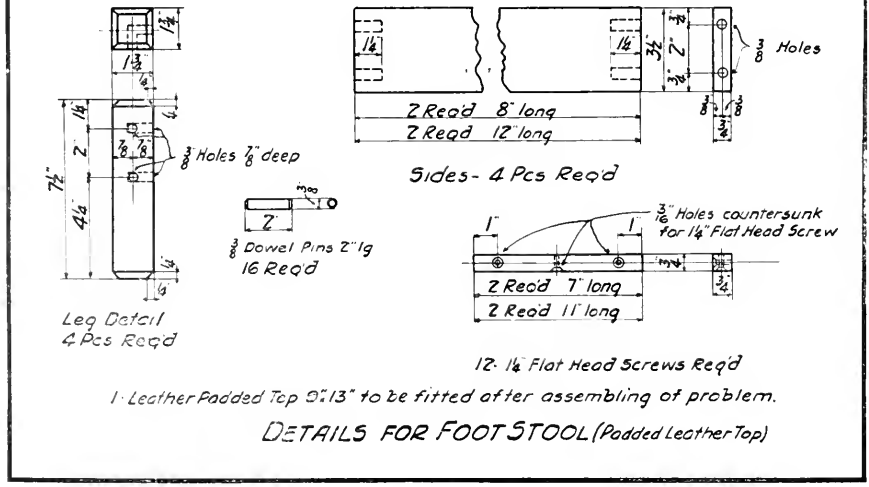
Then shape the top.



FOOT STOOL

Padded Leather Top

PLATE 19



1- Leather Padded Top 9"x13" to be fitted after assembling of problem.

DETAILS FOR FOOT STOOL (Padded Leather Top)

PLATE 19a

LESSON NO. 22

FOOT STOOL

True all pieces and lay out all dowel holes.

Chamfers may be cut with chisel, Fig. 132.

Put on the strips for fastening the top with screws before gluing together.

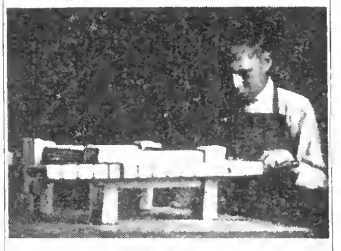
Glue both ends together; be careful to keep them flat and square, Fig. 133. One clamp is enough, though two are sometimes used. It is easier to keep the ends flat by using one on each side. Let the glue dry for twenty-four hours. Be sure to place pieces of wood between jaws of the clamps so as not to mar the surface of the legs of the problem.

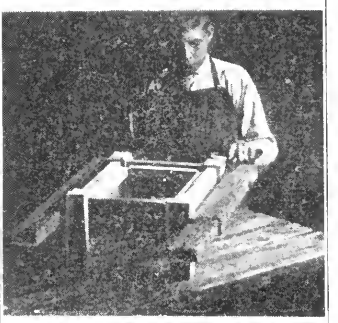
Glue the sides to the ends, Figs. 134 and 135. Keep problem square and let dry for twenty-four hours. Fit the board to be used for the top. Allowance must be made for padding; this will amount to at least ⅛″ all around, depending entirely on how thickly it is padded; it may take ¼″ or more.

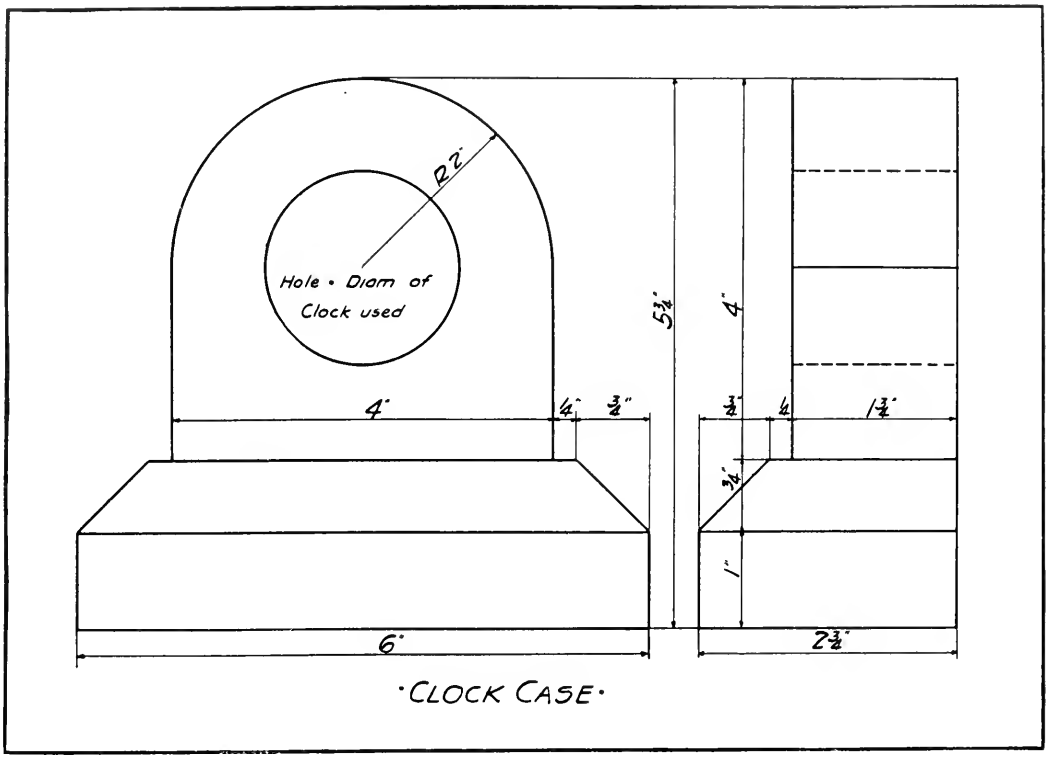
Cotton or hair may be used for padding. Put more in the center than on the edges, and stretch a piece of cheese cloth over the cotton, tacking it on the bottom with short tacks. The leather is then tacked over this and the top set in and screwed from the bottom.

When staining, filling, or waxing, take off the top so as not to soil it.

FIG. 132







·CLOCK CASE·

PLATE 20

LESSON NO. 23

CLOCK CASE

Before working this project secure a small clock 1¾″ to 2¼″ in diameter.

Select any suitable blocks of wood, one for the top and one for the base.

Remove the various projections of the clock, leaving the works and the enclosing case untouched. These are to be inserted into the wood.

Measure the diameter of the clock with a rule.

Mark the diameter on the front and back of top piece, using the dividers.

This is the diameter of the hole when finished.

Within this circle draw another circle ¼″ less in radius, using same center.

On the circumference of the small circle bore ⅜″ holes, close together. See Fig. 136.

With the gouge and rubber mallet cut out the center, Fig. 137.

Place top in vise and trim to required size of hole, Fig. 138. Test by placing clock in the hole.

Assemble and finish.

Note: Any deep mortise of any shape can be made in the same manner, as for example, in a 1″ square mortise, a 1″ hole would be bored and chiseled square.

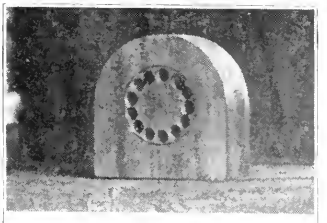
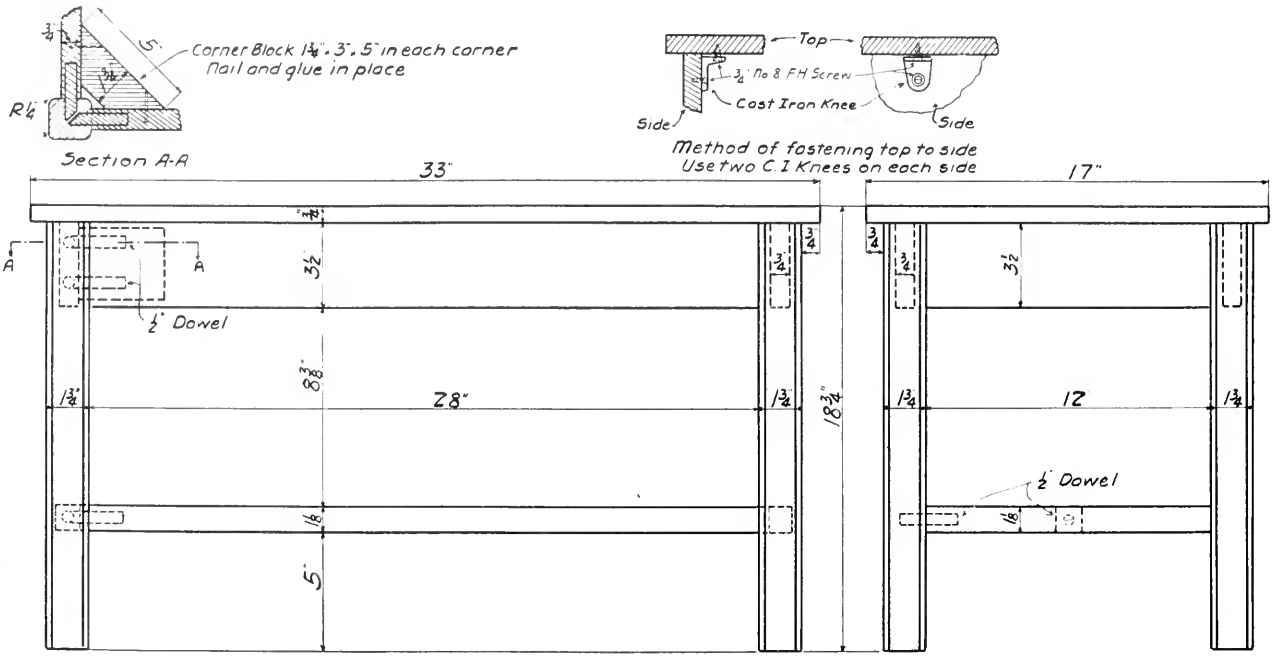


FIG. 136

FIG. 137

FIG. 138



· PIANO BENCH ·

PLATE 21

LESSON NO. 24

PIANO BENCH

Before attempting this or any other large problem, make a careful detail drawing showing each piece as it ought to be when completed. The drawing may be so exact that each part of the problem could be made by a different pupil and the whole assembled as a project without any mistakes.

True all pieces before attempting to assemble any. In laying out the dowel holes carefully match-mark each joint; that is, parts that go together mark with the same figures.

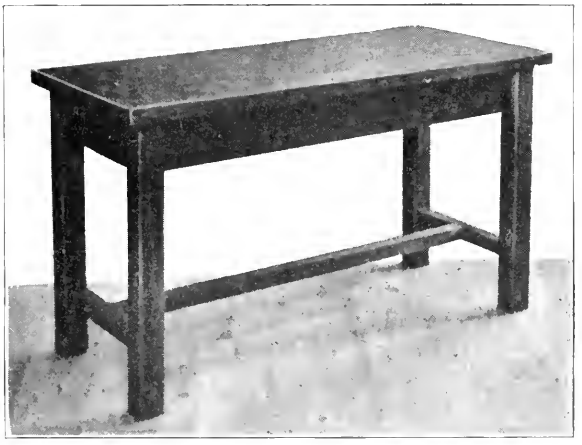


FIG. 139

Glue the ends together. See Lesson No. 22, Fig. 133; only in this problem it is necessary to use at least two clamps, one at the rail and one at the cross piece. Glue the ends to the rails and stretcher, Fig. 140. Test to see if corners are square. Fit corner blocks and nail and glue in place. Plane the top edges of rails and legs flat to receive top. Screw cast iron knees to rails. Be sure to have them about $\frac{1}{16}''$ below the top of sides, so that the top may be drawn down to the sides. Use no glue in fastening the top to the rails, because of expansion and contraction of top.

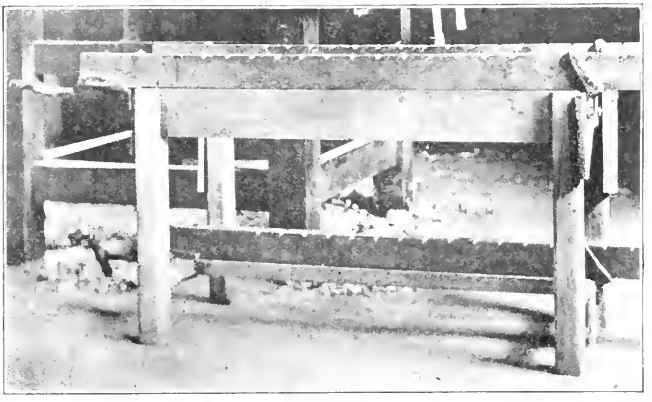


FIG. 140

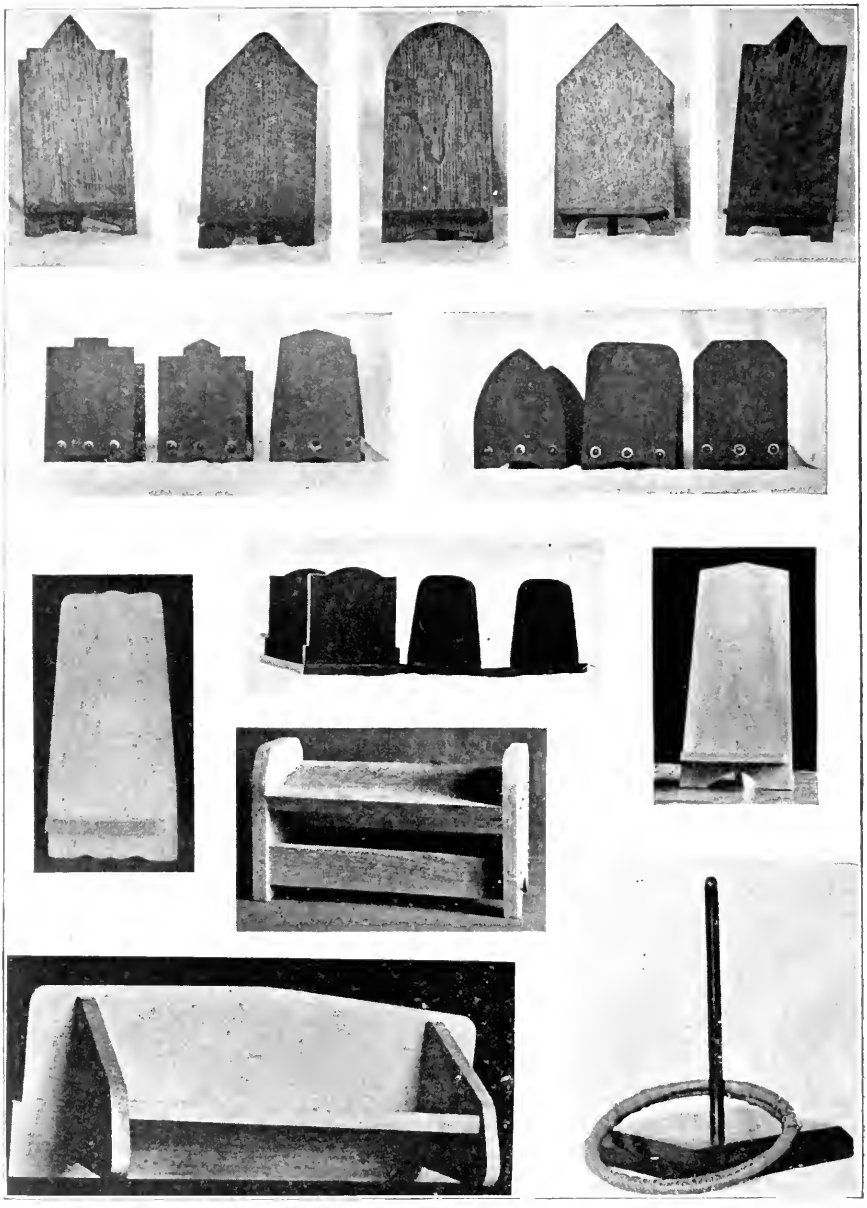


FIG. 141

Figs. 141, 142, 143, and 144 are photographs of finished problems. If any of these are chosen first make a working drawing.

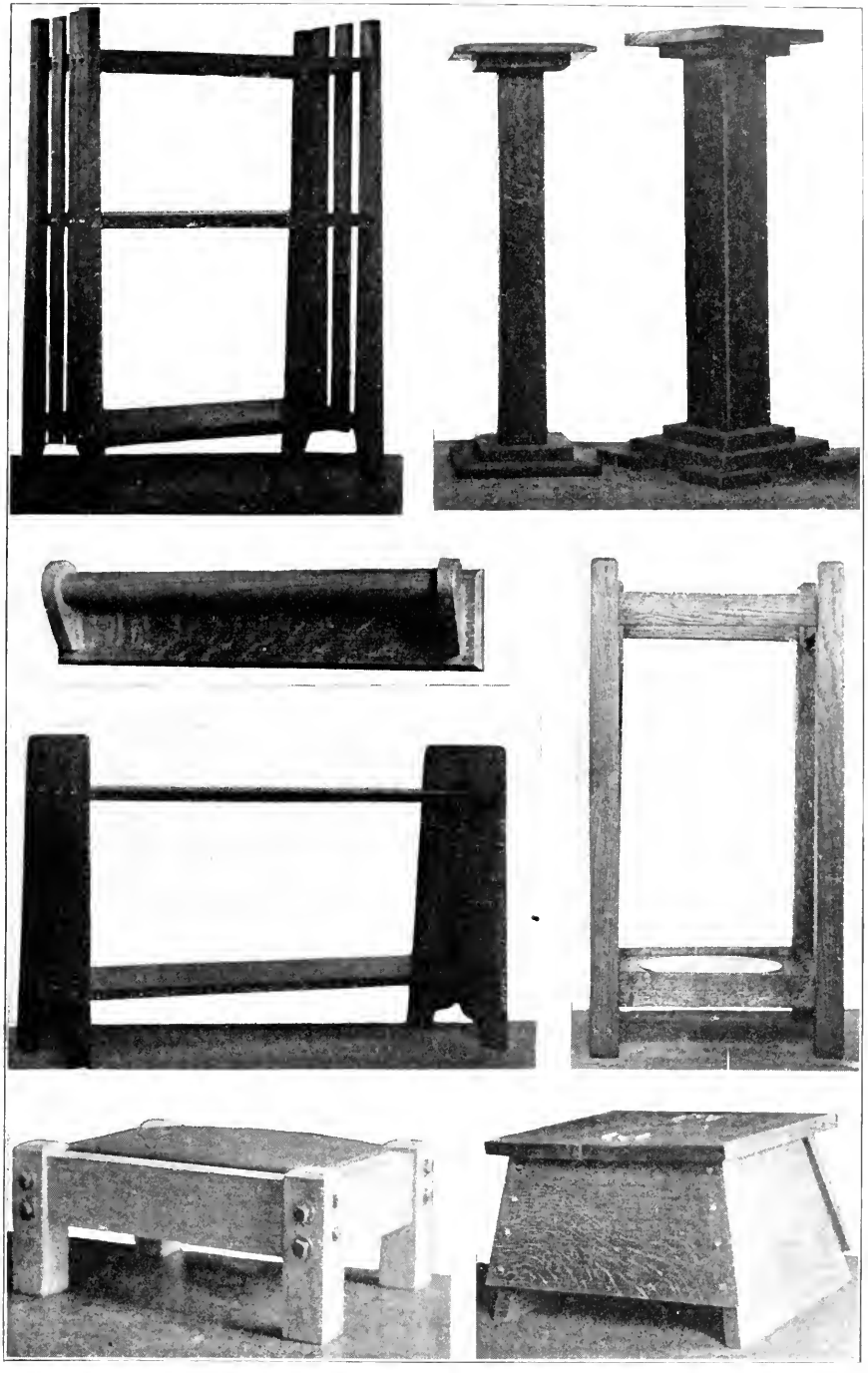


FIG. 142

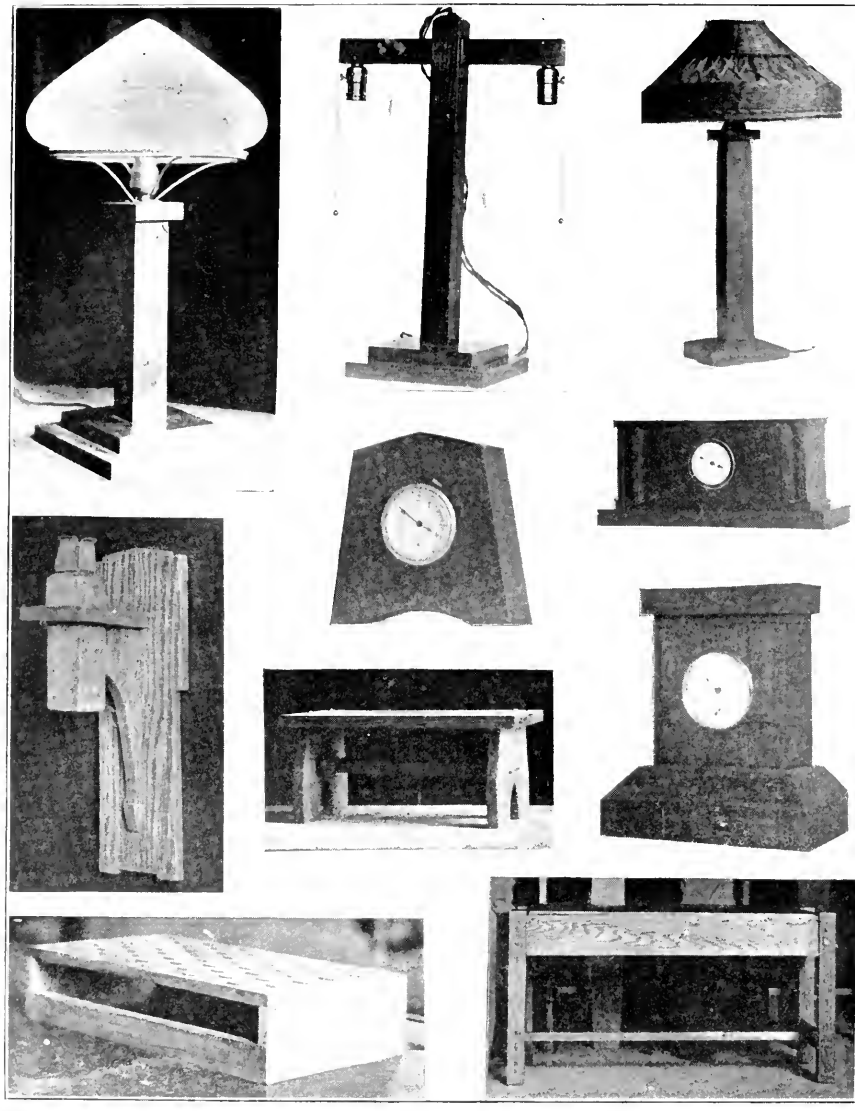


FIG. 143

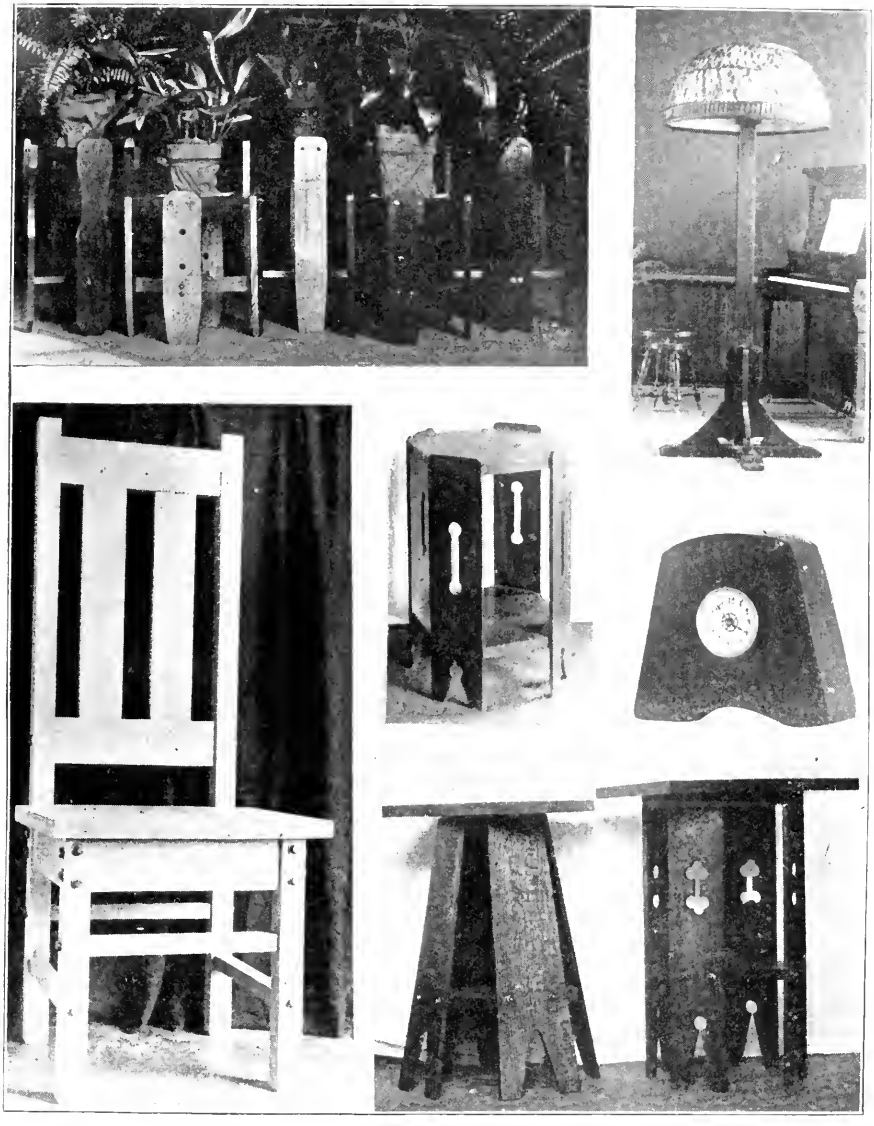


FIG. 144

The trees are cut down. The winter time is the best time for cutting, as there is less sap in the tree at this time of the year. The summer is the next best, the fall and the spring being the least favorable times. The trees are stripped of their branches and shipped to the saw mill. Here they are sawed into timbers, planks, boards, etc.

Seasoning. Lumber cut from freshly felled trees is not fit for use in permanent structures of any kind, as it is green. It

FIG. 145

Upper, sawing logs into lengths; lower, a large load of white pine logs; right, yellow pine in a southern forest.

contains sap and moisture which will evaporate and cause the lumber to shrink, especially across the grain. Some woods shrink as much as one inch to a board twelve inches wide. In length lumber shrinks very little. It is evident what would become of a structure made from wood in this condition. To prevent this the lumber is seasoned. That is, it is piled in a stack in such manner that the air may circulate around each piece. It is left in these stacks for a period ranging from three months to four years, depending on the lumber, its thickness,

and the use for which it is designed. Some of the best grades of lumber are placed under open sheds to dry to protect them from snow, rain, and the direct rays of the sun. Too fast drying causes checks and cracks.

Kiln Drying. Lumber that is used for furniture should be kiln dried as well as air dried. The lumber is piled into a room that is heated by steam. The temperature is slowly raised to about 180° F., and the lumber is left in this room from four days to four weeks, depending on the thickness and kind of lumber. In some kilns today the lumber is kept in live steam for the first few days. In this way much of the sap is washed out of the wood. Some manufacturers claim many disadvantages for this last method, and it is not generally used.

Dressed Lumber. Lumber for cabinet work or any fine carpenter work is usually dressed on two sides, or, in other words, is planed with a machine planer on both faces. Lumber dressed in this manner is known as S-2-S or surfaced two sides. If it is only surfaced on one side, as is the case of fence boards, it is known as S-1-S. Lumber that has been surfaced on both faces and both edges is known as S-4-S.

S-1-S means plane 1 surface and size to thickness.

S-2-S means plane 2 surfaces and size to thickness.

S-4-S means plane 2 surfaces and 2 edges and size to thickness and width.

S-1-S-1-E means plane 1 surface and 1 edge and size to thickness and width.

Before starting to plane the board it is well to know the terms generally used to denote the different surfaces. The two large surfaces are called the faces. The two narrow surfaces, running with the grain of the wood, are called the edges. The two surfaces running across the grain of the wood are called the ends.

FINISHING

1. **Finishing** is the term used for the protecting and beautifying coat that is given the wood. It may be paint, shellac, stain, wax, varnish, or any suitable combination of these, such as stain and wax, stain and shellac, stain, filler and shellac, and varnish, or any other combination which will protect and beautify the wood.

2. **In cabinet work** finish plays a most important part. Wood without a protecting coat of some kind will soon crack, warp, twist, and lose its beauty. To protect the wood a coating is needed that will keep the air and moisture out of the wood. For woods that have little or no beauty, paint is used. For lawn furniture paint is very satisfactory as it stands the weather better than varnish.

3. **Paint** is a mixture of raw or boiled linseed oil, pigment, and a dryer. Linseed is the oil extracted from flax seed. The pigment is the coloring matter. It may be white lead, zinc white, yellow ochre, lamp black, or many others too numerous to mention, depending on the color wanted. The dryer is the oxidizing agent to dry the linseed oil into a hard film.

4. **Staining** is to wood as dyeing is to cloth. All colors are not appropriate to wood. Prussian blue should never be used on any kind of wood.

5. **Almost any color**, if not subdued, will spoil rather than beautify the wood. Stain should be transparent and enhance the wood.

6. **Stains** are divided into the following:

7. (a) **Water Stains**, which stain deeply and give some effects which cannot be obtained in any other way. They raise the grain of the wood, and for this reason are not always desirable for manual training work.

8. (b) **Spirit Stains**, which are made with alcohol, also stain deeply, but do not raise the grain of the wood; the only objection to them is that some stains that are manufactured tend to lap when used in the hands of the boys.

9. (c) **Oil Stains**, which are very good for manual training, but little trouble being encountered with them. All stains are put on in much the same way.

10. **Directions for Use.** Have the wood well planed and finely sandpapered, then apply the stain freely with a brush; allow it to remain on the surface from three to thirty minutes, after which wipe off the surplus stain which has not struck in.

11. **The depth of shade** can be regulated by applying the stain more or less freely, and also by varying the length of time before wiping it off. Allow twenty-four hours or more for the stain to dry thoroughly.

12. **In finishing open grained woods,** such as oak, ash, mahogany, and chestnut, stain as above directed, and then fill with paste wood filler. See Section No. 15. After the work has been filled, complete the finish by applying shellac, varnish, or wax according to the finish desired.

13. **On the close grained woods,** such as pine, cypress, and birch, do not use fillers.

14. **A wax finish** can be obtained by applying a thin coat of shellac, and finishing with Standard Prepared Wax.

15. **Filler.** Thin with turpentine or benzine to the consistency of flowing varnish; apply it to the surface of the wood with a brush, going over no more surface at a time than will admit of being cleaned off before hardening. After the filler has set, giving the appearance that the gloss has left it, rub off with excelsior, shavings or cloth. Rub across the grain when practicable; then clean out the crevices with a sharp stick; after which wipe the whole problem thoroughly with a cloth or rag. Should the filler at any time wipe off too hard, or dry too fast for the work, add a little linseed oil, just sufficient for the purpose intended. Allow twenty-four hours to dry. Then apply shellac, varnish, or wax, whichever is preferred.

16. **Shellac** is gum dissolved in alcohol and is of two kinds, white and orange. The white is nearly transparent. The orange shellac is, as its name implies, orange in color. For manual training work the white is preferable because it is difficult for a boy to apply the orange. If the coats are not put on evenly an unsightly smeared appearance results.

17. **Keep the shellac** in covered tin cups and use rubber-set brushes, as the bristles do not come out of them so easily. Keep the shellac thin.

18. **In flowing shellac** put it on quickly with a 1½″ or 2″ chisel brush. Do not go over the surface more than once as the shellac sets rapidly and cannot be brushed out. Laps will show if you do. Sandpaper carefully after each coat is dry, using sandpaper without a block of wood, holding it in the tips of the fingers.

19. **Copal varnish** is made from copal gum, linseed oil, and turpentine. The oil and gum are first boiled together and then the turpentine is added. The compound is drawn off in vats and allowed to age and settle. The time for aging varies from one month to a year or more, depending upon the quality and kind of varnish made.

20. **To flow copal varnish** use it as it comes from the manufacturer. If it is too thick place it in a warm room for twenty-four hours. If it is then too thick add a small quantity of turpentine. In flowing the varnish use 1½″ or 2″ chisel varnish brush; put varnish on quickly and thick. Wipe the varnish out of the brush into the can and then pick up all the surplus varnish with it. It may be necessary to dry the brush again. The varnish should be brushed out thin enough so that it will not run. Then let it dry from one to three days, depending on the kind and quality. It should not feel sticky when dry. Sandpaper after each coat is dry, but not after the last. The room in which the varnishing is done must be free from dust, warm, and well ventilated.

21. **Wax. The exact composition** of the wax manufactured for use is kept secret by the manufacturers.

22. **In applying** any of these waxes it is well to read carefully the directions on the can. The general directions which will apply to all waxes are: Have the surfaces planed smooth and finely sandpapered. In open grained wood, such as oak, ash, etc., fill with paste filler. See section No. 15. When filler is dry, apply a coat of wax, using a piece of cloth or brush. Let dry from five minutes to half an hour, depending on the kind of wax used. Polish with a stiff brush or cloth, allowing first coat twenty-four hours to dry. Apply a second coat in the same manner. Should a higher gloss be desired, as on soft woods, give a thin coat of shellac, and sandpaper before applying the wax.

HARDWARE

Nails may be had in either the cut or wire variety and they are made in varying lengths with diameters suitable to the use for which they are manufactured. Cut nails, made from sheet steel or iron, have ceased to be generally used in the present day building operations. Wire nails, made from steel wire of the diameter desired when finished, have now generally replaced cut nails. In ordering nails read the letter d as "penny" and use the following scale as a guide:

LENGTH OF NAILS

2	3	4	5	6	7	8	9	10	12	16	20	30	40	50	60d
1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	4½	5	5½	6in.

Brads, nails with small heads, are generally ordered by length and gauge, ranging from 3/16″ to 3″ in length and gauged by numbers to indicate the diameter.

No. of Gage	Decimal Equivalent	No. of Gage	Decimal Equivalent	No. of Gage	Decimal Equivalent	No. of Gage	Decimal Equivalent
1	.2830	6	.1920	11	.1205	16	.0625
2	.2625	7	.1770	12	.1055	17	.0540
3	.2437	8	.1620	13	.0915	18	.0475
4	.2253	9	.1483	14	.0800	19	.0410
5	.2070	10	.1350	15	.0720	20	.0348

Screws, made of iron or brass, come in sizes from ¼″ to 6″ and in gauges from 0 to 30. One large manufacturer catalogues screws 1½″ long in 19 different gauges. In ordering screws give the length in inches, and the gauge number. The following is the gauge generally used and the table gives the equivalent in decimals of an inch:

No.	Inch	No.	Inch	No.	Inch	No.	Inch	No.	Inch
0	.0578	5	.1236	10	.1894	15	.2552	22	.3474
1	.0710	6	.1368	11	.2026	16	.2684	24	.3737
2	.0842	7	.1500	12	.2158	17	.2816	26	.4000
3	.0973	8	.1631	13	.2289	18	.2947	28	.4263
4	.1105	9	.1763	14	.2421	20	.3210	30	.4520

In common use there are five kinds of screws,—lag, round-head, flat-head, fillister-head, and oval-head. Lag screws are ordered by length and diameter, in inches.

In preparing wood for screws holes must first be bored, and if flat or oval-head screws are to be used the hole must be counter-sunk. The diameter of the hole bored in the upper piece of wood must equal or be a trifle larger than the diameter of the screw. In the under board the hole must be smaller in order that a good thread may be formed in the wood. For example, — a No. 8 screw is about 11/64″ in diameter; for this screw use a 3/16″ bit for the upper board, and a ⅛″ bit for the lower board if it is hard wood; if it is soft wood use a 3/32″ bit.

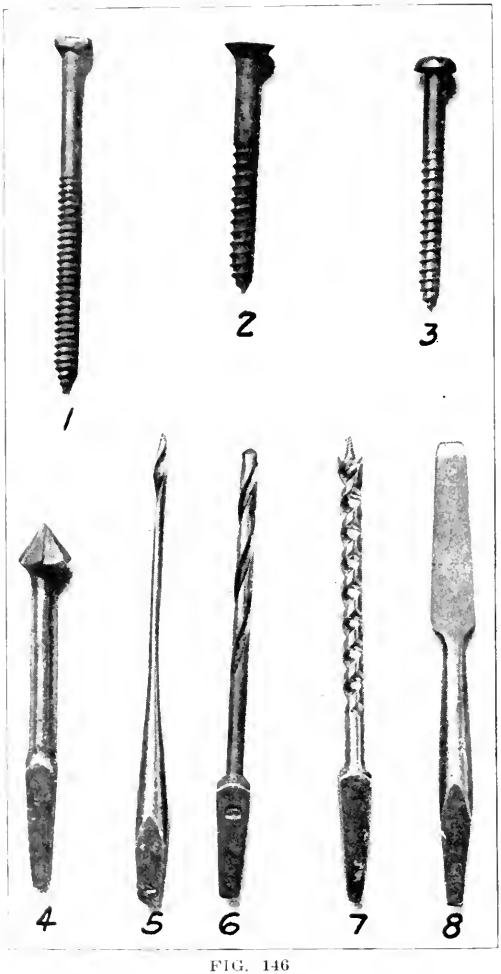


FIG. 146

1, Lag Screw; 2, Flat Head Screw; 3, Round Head Screw; 4, Rosette Countersink; 5, Gimlet Bit; 6, Twist Drill; 7, Dowel Bit; 8, Screw Driver Bit.

In boring holes for screws an automatic boring tool is very handy. The drills for these tools come in different sizes from 3/64″ to 12/64″, by 64ths.

Gimlet bits come in sizes from 2/32″ to 3/8″ by 32nds. The sizes are marked on the shank. For example,—a 3/16″ bit is marked 6, and a ¼″ bit is marked 8.

Hinges, locks, clasps, screw eyes, screw hooks, handles, coat hooks, etc., come in a large variety of styles and qualities, the best way to gain an idea of their variety being to see some of the catalogues that are put out by the different manufacturers.

MECHANICAL DRAWING

In the manufacturing field today the making and reading of working drawings is becoming as important as the reading and writing of the language of the country. The reasons for this are manifold. Foremost among them is economy of labor and material, which accurate drawing makes possible. With the advance in building and engineering even the lowest paid workmen are required to be able to read working drawings. Owing to the division of labor, each individual must make his part to fit in with the parts made by others in order to complete the project.

It would be impossible to build one of our skyscrapers without the use of working drawings. The steel work, for instance, in these buildings is often completed before the foundations are finished, and measurements are only taken from drawings.

One need not go to these great complicated pieces of work to find working drawings in use. Even in the small shops one finds the men working almost entirely from drawings made by someone else, an architect for example.

Drawing is to the manufacturer the same as writing is to the author, a means of conveying ideas to another. Though in writing there are many languages, in drawing, no matter what language the draftsman speaks, his drawings will be understood with the exception of his notes which are on the drawing. In a well worked-out drawing a thorough knowledge can be had of what is meant without reading the notes.

The Tools Generally Used in Mechanical Drawing Are:

(a) The drawing board, a rectangular board made of soft wood so that the thumb tacks may be easily put in and drawn out of it. The edges should be square and straight. Drawing boards come in many sizes and styles, usually from 12″x17″ to 60″x84″. In manual training the small board, 12″x17″, is large enough, though it is well to have a larger board in the shop; one 36″x48″ will take care of any kind of drawing that may be attempted in the ordinary course of the work.

(b) The tee square, which is a straight edge made of wood, or sometimes of steel, with a cross piece at one end, which in

most tee squares is fixed. In the more expensive ones, one side of this crosspiece is fixed and the other side is adjustable. In the one with the fixed cross piece, or head, as it is sometimes called, the cross piece is at right angles to the straight edge. In the others any angle can be had by adjustment. Many of the better straight edges now have transparent edges about $\frac{1}{2}''$ wide. These are very convenient as they enable the draftsman to see the lines under the square.

(c) The drawing triangle, which always has one right angle, the other angles varying. These angles give the triangle its name, such as the 45° and the 30°-60° triangle. There are other triangles, but these two are universally used, some draftsmen possessing only these two.

(d) The scale, which need only be a rule with the ordinary divisions into eighths and sixteenths, is made in different styles to suit the convenience of the draftsmen. The one shown in the cut is triangular in shape and made of box wood. It has eleven different scales. This makes it very popular among draftsmen.

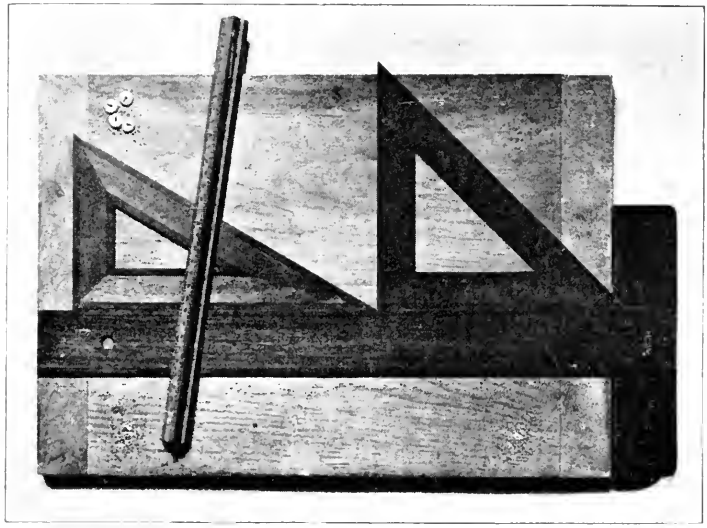


FIG. 147

Photograph of Drawing Board, Tee Square, 45° Triangle, 30°-60° Triangle, Thumb Tacks, and Triangular Scale.

(e) The compass, used for drawing circles, which comes in all qualities and prices.

(f) The dividers, which are used for spacing equal distances.

(g) The ruling pen, which is used for inking lines.

(h) The bow compasses and dividers, which are used where greater accuracy is required. They are operated by means of a round milled nut and screw, and can be set very fine.

(i) The lengthening bar, which is used to increase the size of the compass.

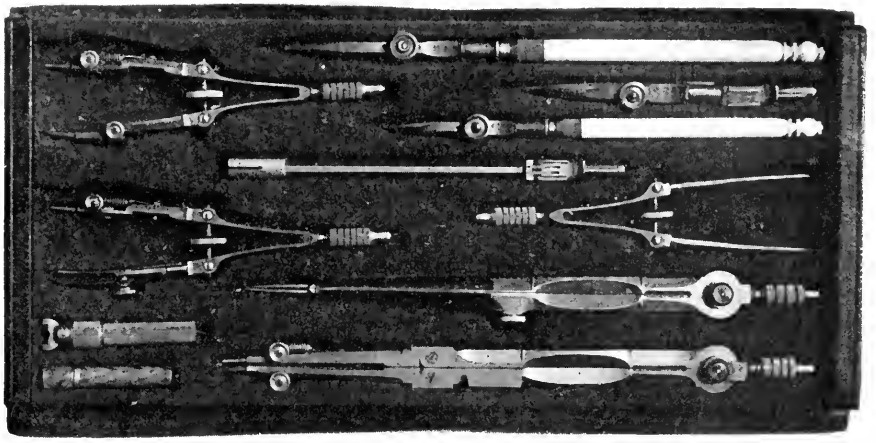


FIG. 148
Photograph of a set of drawing instruments.

(j) Rubber erasers, which are made for both ink and pencil erasing. A soft eraser is the best, one that least spoils the surface of the paper in erasing.

(k) Erasing shields, which are used in erasing lines or blots without spoiling the rest of the drawing.

(l) Protractors which are used for the measuring of angles, and are generally made of metal.

(m) Ink, which is black. A waterproof carbon ink is generally used, and comes prepared. Inks may be had in any color, most of which are not waterproof, and these may be mixed together or with water to give different colors or shades of color.

(n) Paper for pencil work, which is commonly known as detail paper. It is cream colored and tough, and stands erasing well. It comes in different weights and grades, depending on the character of the drawings to be made. For complicated drawings the best should be used. Paper for ink drawings is white, and may be smooth, medium rough, or rough.

(o) Pencils, which should be high grade graphite, ranging from H. B. to 9 H. For general use in manual training a 3 H pencil is the best.

(p) Tracing cloth, which is a linen cloth with a preparation on it that makes it transparent.

(q) Tracing paper, which is a transparent paper to take the place of tracing cloth. It is cheaper, but not nearly so good, and is used only in cheap drawings.

Processes in the Ordinary Drafting Room

1. A free-hand sketch is first made of the object with its conditions.

2. A pencil drawing is made on detail paper to scale, with drawing instruments. This is carefully checked to discover any inaccuracies.

3. A sheet of tracing cloth is placed over the pencil drawings and with a ruling pen the drawing is inked on the tracing cloth. This is again checked and if any mistakes are found they are corrected.

4. The drawing is now ready for blue prints to be made. In large cities these tracings are generally sent to some blue print concern which makes it a business to print them. If the draftsman makes his own prints, he uses blue print paper, which is a white paper with an emulsion on it that is sensitive to light. A printing frame, very much like one used in photography, only larger, with a glass in it, is used. The tracing is placed in the frame toward the glass and the paper with its sensitized surface next the tracing. Then the back is put on which holds the paper against the cloth. It is exposed to the sunlight until the paper has a bronze tinge. Then it is removed from the frame and washed in salt water. The black lines on the tracing have protected that part of the paper from the light. When the

washing is finished the paper is blue with the exception of the places where there were lines on the tracing. These lines remain white, thus giving a blue background with white lines. Now the prints are hung up to dry. As many prints can be made as desired from the same tracing.

5. Machines are now made to produce blue prints. They are lighted by electricity. Sometimes the tracing and paper are fed at one side of the machine and at the other side the print, all finished and ready for use, is produced in about two or three minutes.

GENERAL DIRECTIONS FOR MECHANICAL DRAWING

1. Fasten paper to drawing board with thumb tacks.

2. See that upper edge of paper is parallel with upper edge of tee square when head of tee square is held against left-hand edge of board.

3. Parallel lines, horizontal, vertical, and diagonal, constitute simple definite problems.

4. To draw horizontal parallels

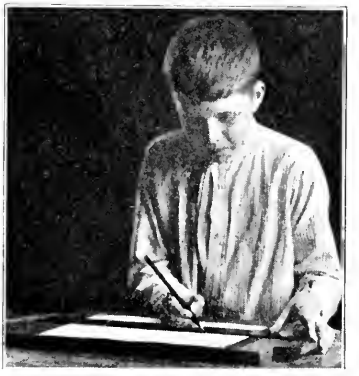


FIG. 149

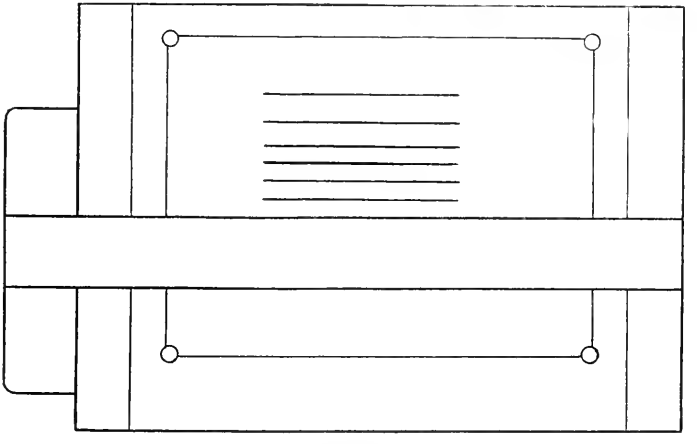


FIG. 150

Illustration showing the use of Tee Square in drawing horizontal parallels.

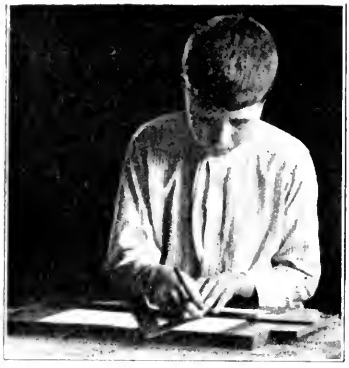


FIG. 151

hold head of tee square against left-hand side of drawing board; push it up or down as needed. See Figs. 149 and 150.

5. To draw vertical parallels hold tee square as before. Place triangle so that right angle touches tee square, and move triangle back and forth along tee square as needed for lines. Figs. 151 and 152.

6. To draw parallels at 45° set tee square as before, placing 45° angle of triangle on tee square, and moving triangle back and forth as needed.

7. It would in many cases be impossible or inconvenient to draw all projects full size. For this reason drawings are made to scale. That is they are made half size, quarter size, eighth size, etc. In fact any scale will do that fits the convenience of the draftsman. The scales generally used are: 6″=1′-0″; 3″=1′-0″; 1½″=1′-0″; ¾″=1′-0″; ⅜″=1′-0″; 1″=1′-0″; ¼″=1′-0″, and ⅛″=1′-0″.

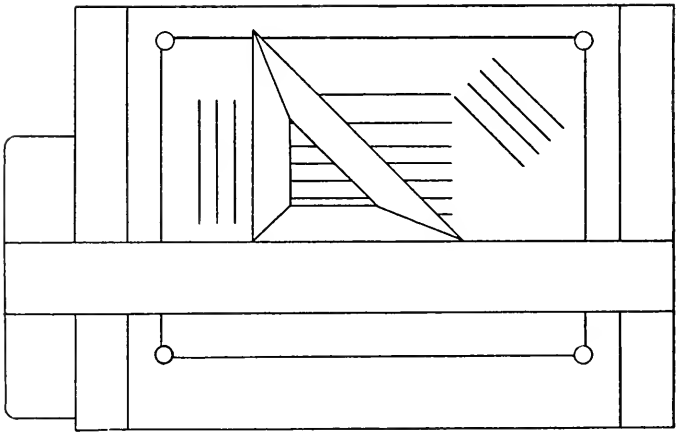


FIG. 152

Illustration showing the use of Tee Square and Triangle in drawing vertical parallels and parallels at 45° to vertical.

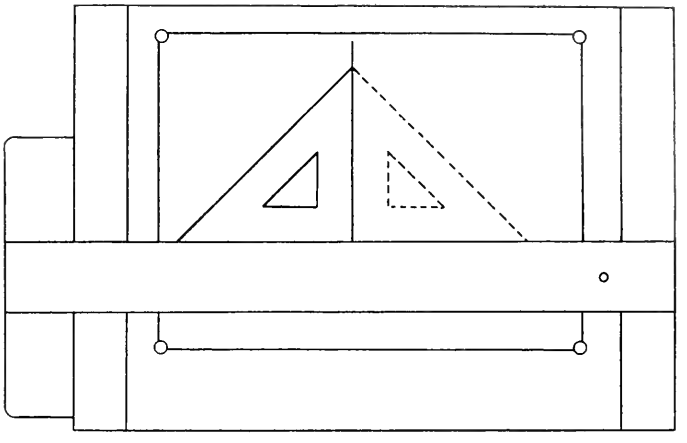


FIG. 153
Illustration showing the method of testing the 90° angle of a triangle.

7. To draw parallels at any angle omit the use of tee square and use two triangles, making one the guide.

8. Lines are important in mechanical drawing. The kinds used are as follows (See Fig. 155):

All these points are illustrated throughout this text.

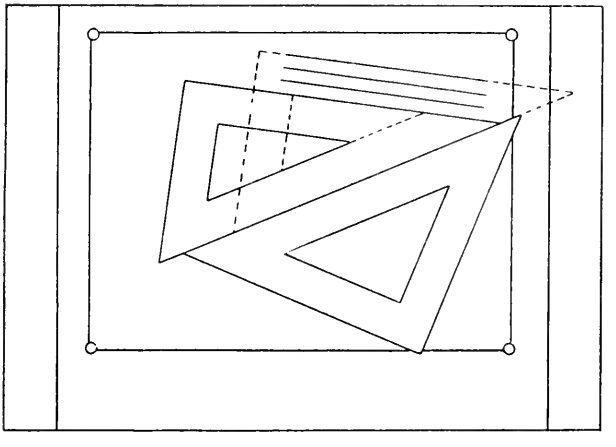


FIG. 154
Illustration showing the use of two triangles in drawing parallel lines at any angle.

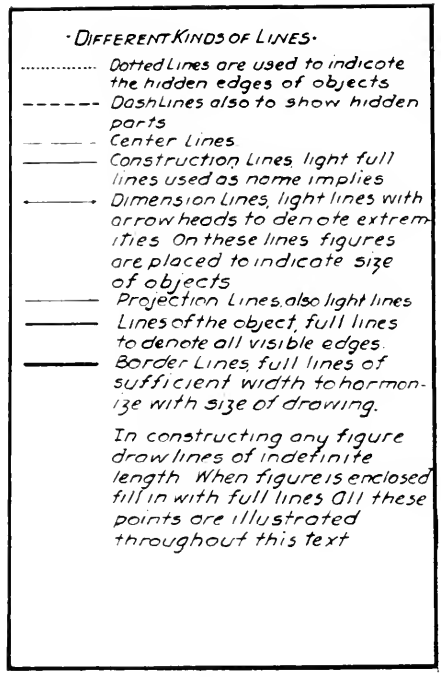

·DIFFERENT KINDS OF LINES·
Dotted Lines are used to indicate the hidden edges of objects
Dash Lines also to show hidden parts
Center Lines
Construction Lines, light full lines used as name implies
Dimension Lines, light lines with arrow heads to denote extremities. On these lines figures are placed to indicate size of objects
Projection Lines, also light lines
Lines of the object, full lines to denote all visible edges
Border Lines, full lines of sufficient width to harmonize with size of drawing.
In constructing any figure draw lines of indefinite length. When figure is enclosed fill in with full lines. All these points are illustrated throughout this text

FIG. 155

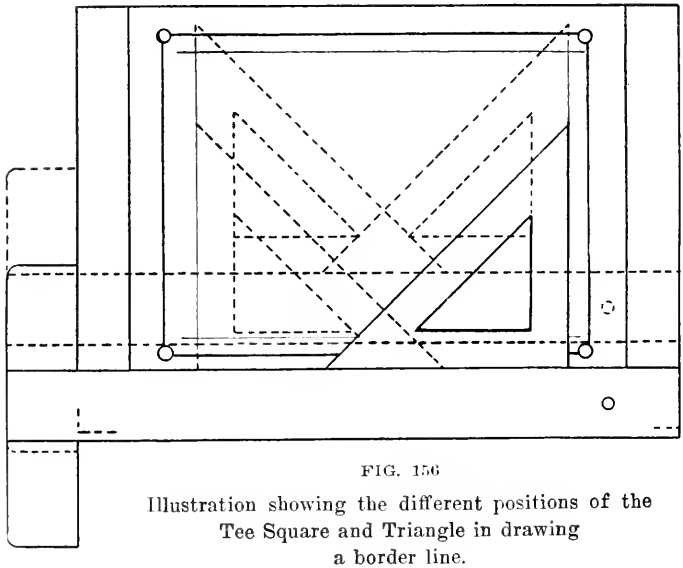


FIG. 156

Illustration showing the different positions of the Tee Square and Triangle in drawing a border line.

LESSON NO. 1

Drawing Exercise to Illustrate Use of Tee Square, Triangle, Compass, and Scale

1. Draw border line 1″ from left-hand edge of paper and ½″ from all other edges.

2. Bisect the enclosed rectangle vertically and horizontally.

3. In upper left-hand rectangle draw horizontal lines ¼″ apart; use tee square. See page 78.

4. In upper right-hand rectangle draw vertical lines ¼″ apart; use tee square and triangle.

5. In lower left-hand rectangle draw diagonal lines 45° to the horizontal; use tee square and 45° triangle.

6. In lower right-hand rectangle draw both diagonals and both diameters. Use light lines. Mark center.

7. Around this center draw a circle 2″ in diameter. Use compass.

8. Within this circle inscribe a square on the diameters. Use a tee square and 45° triangle.

9. Circumscribe a square around this circle. Use tee square and triangle.

10. Using the center in (7) draw a circle 3″ in diameter. Use compass.

11. Circumscribe this circle with a square. Draw in light lines. Use tee square and triangle.

12. With tee square and 45° triangle draw diagonal lines tangent to the circle in (10). The resulting enclosed figure is an octagon.

13. The completed figure consists of: (a) 2″ circle with an inscribed and circumscribed square. (b) a 3″ circle with a circumscribed octagon.

See plate 22.

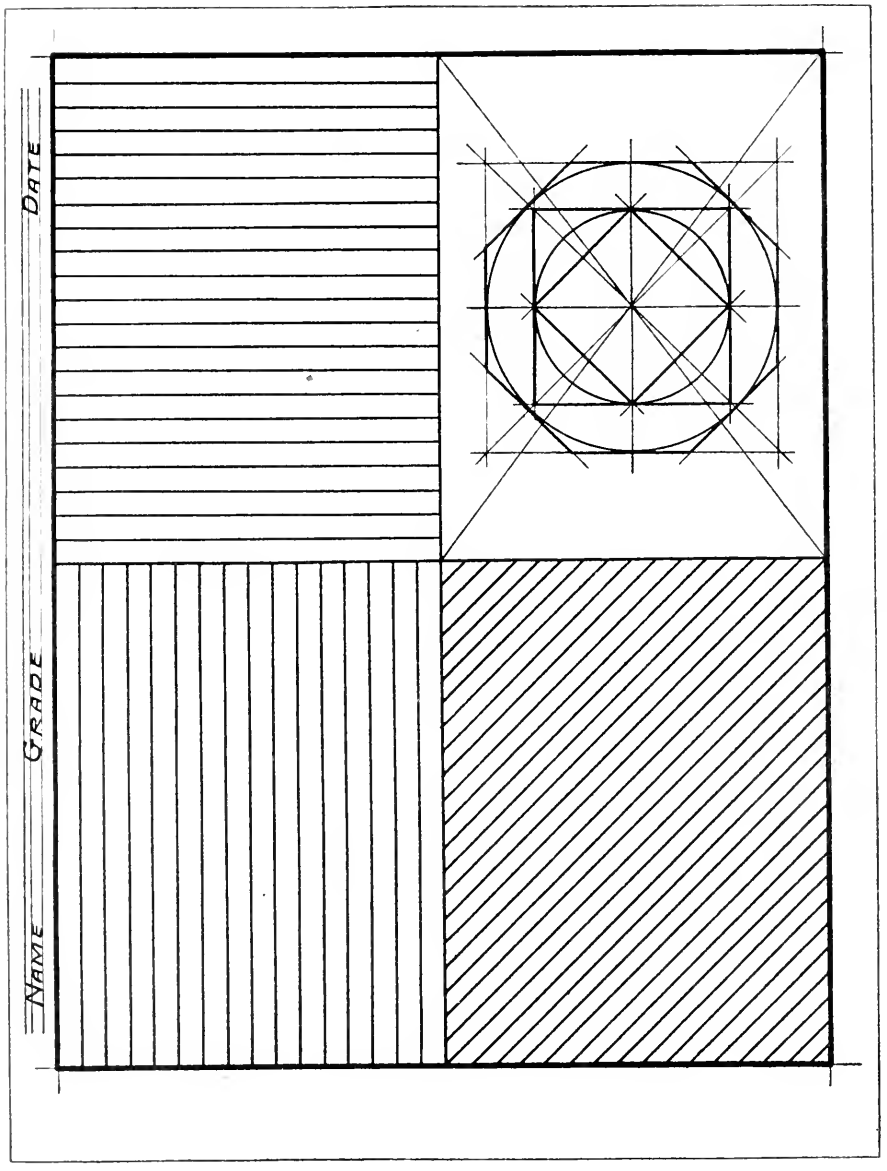


PLATE 22

EXERCISES PRELIMINARY TO WORKING DRAWINGS

LESSON NO. 2

To Find Horizontal and Vertical Axes of Projection.

1. Select any rectangular prism no dimension of which exceeds 4″.

2. Secure three pieces of ordinary window glass each 6″ square.

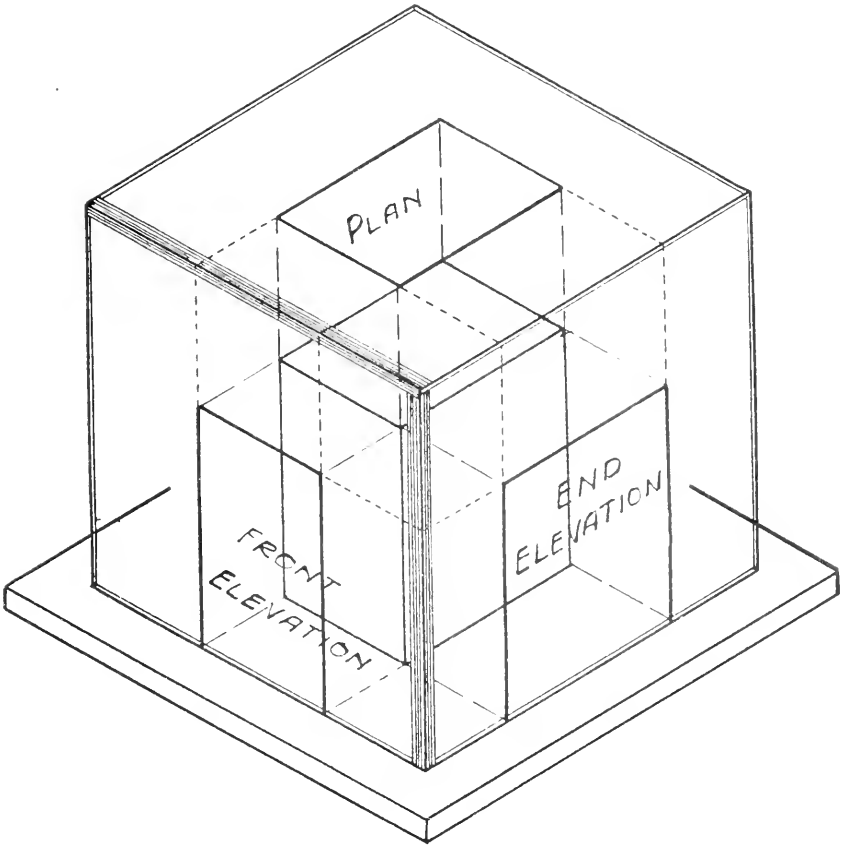


FIG. 157

Isometric drawing of a glass projection box with block in it. See Lesson No. 2, Sections 1, 2, 3, 4, 5, 6, and 7.

3. Set these three pieces of glass together with cloth hinges, letting them thus enclose the rectangular prism.

4. Look down from above at the top of the prism. With a piece of chalk trace the lines you see on the glass.

5. From directly in front trace a front view on the glass.

6. From a direct side study trace a side view.

7. With dotted lines extend all these lines towards the glass sides. These dotted lines will intersect similar lines of the three views.

8. Remove the prism. Open the glass figure on a suitable sheet of paper.

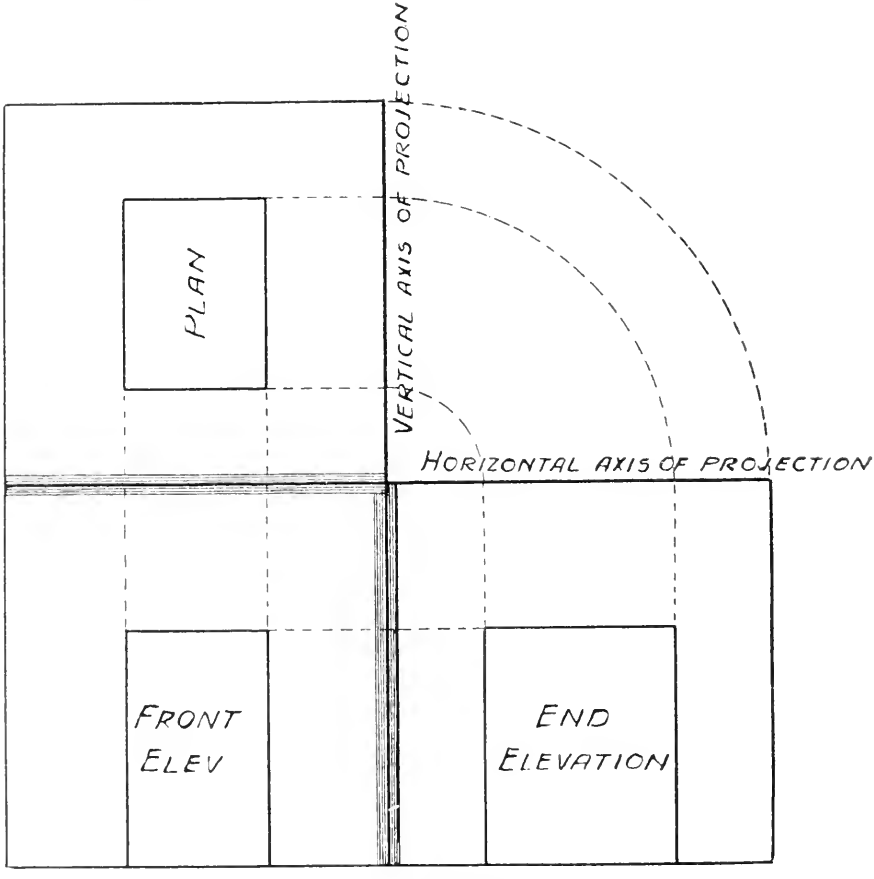


FIG. 158
To illustrate Lesson No. 2, Sections 9, 10, 11.

9. We now have the horizontal axis of projection which is the line extending through the hinge between the top and front and continuing through the top of the other view. We also have the vertical axis of projection at right angle to this.

10. The top view is known as the plan; the one below the top is known as the front elevation; the other view is the end elevation.

11. In the square not covered by glass continue the dotted lines of the top view from the vertical axis to the horizontal axis.

12. In good sentences give an oral description of the entire lesson.

LESSON NO. 3

To Make and Read a Working Drawing

1. Review Exercise 2, studying all features.

2. Make a drawing to represent same.

3. Enclose this drawing in suitable border lines.

4. Put in the two axes in full lines.

5. In place of the dotted lines used on the glass use light projection lines.

6. As a new problem make another drawing, using measurements, of a rectangular prism 4″x2″x1½″.

Note: The methods used in Exercises 2-3 may be applied to any geometric solid. See Fig. 159. Draw as many views as are needed for the complete details of any object.

LESSON NO. 4

To Make a Working Drawing of the First Object to be Constructed

1. Select the object—some one-piece simple problem.

2. Study its details and take its measurements.

3. Then make a working drawing full size.

4. Put in dimension lines, keeping them ¼″ away from object.

5. The axes of projection may now be omitted.

Note: Have many similar exercises to develop facility in both reading and making drawings. To older pupils there should be given some exercises in geometric drawing, such as bisecting an angle, constructing a hexagon and the like, as these problems arise in connection with advanced manual training work. See Plate 23.

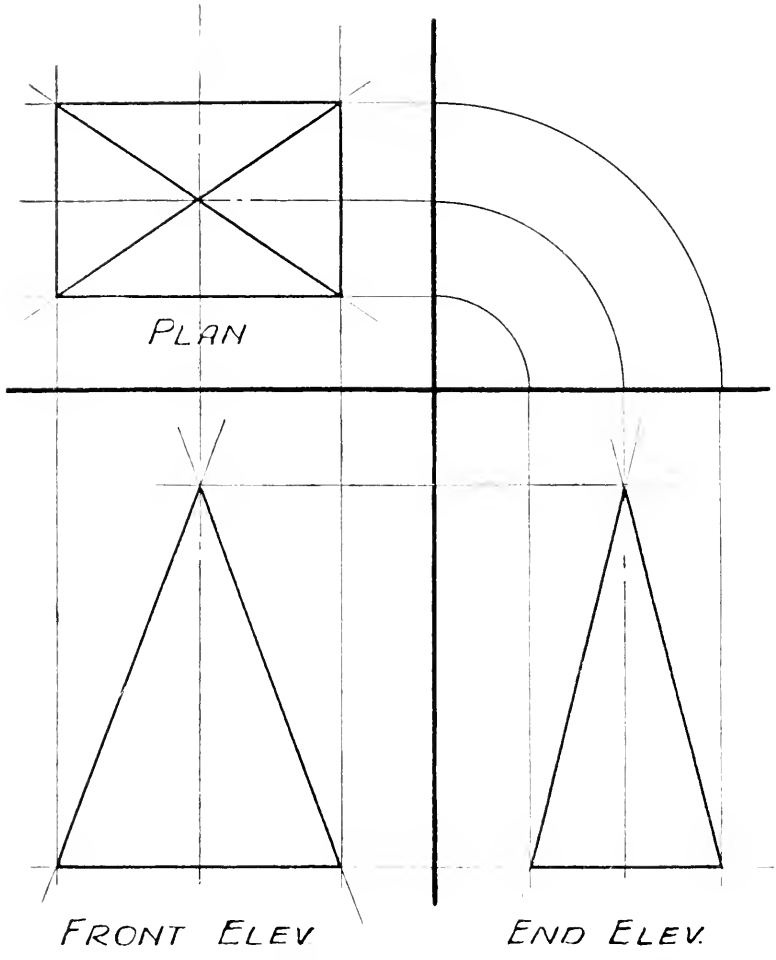
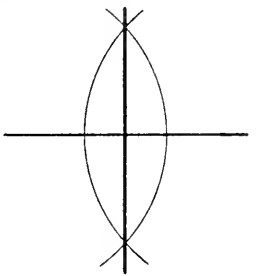


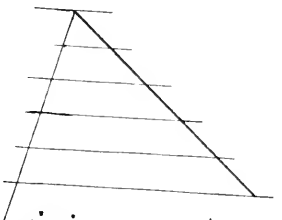
FIG. 159

Projection of a rectangular pyramid showing the axes of projection.

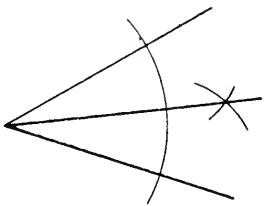
NAME GRADE DATE



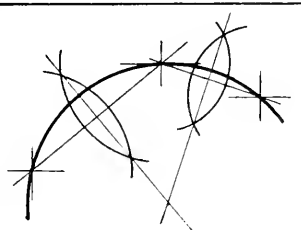
To bisect a line



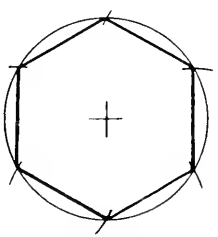
To divide any line into any number of equal parts.



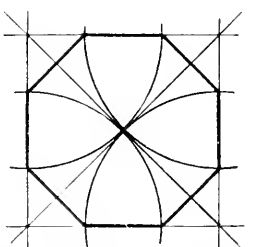
To bisect an angle



To draw a circle through any three points

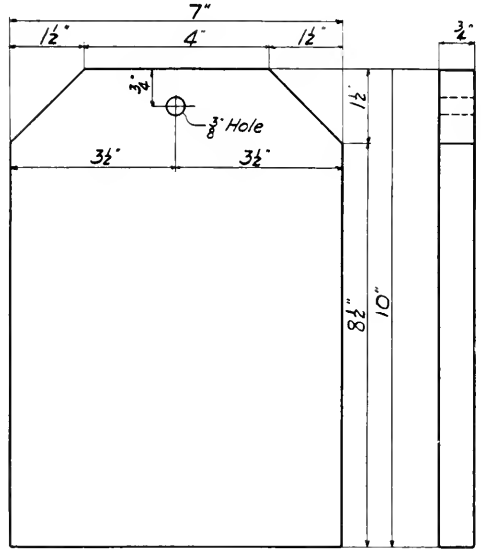


To draw a hexagon



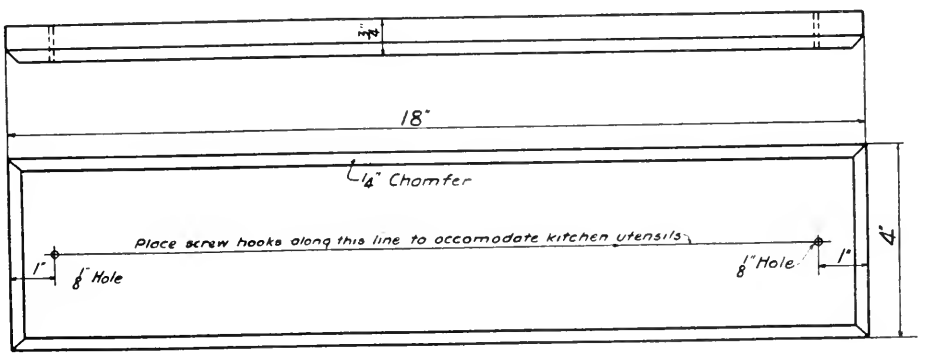
To draw an octagon

PLATE 23



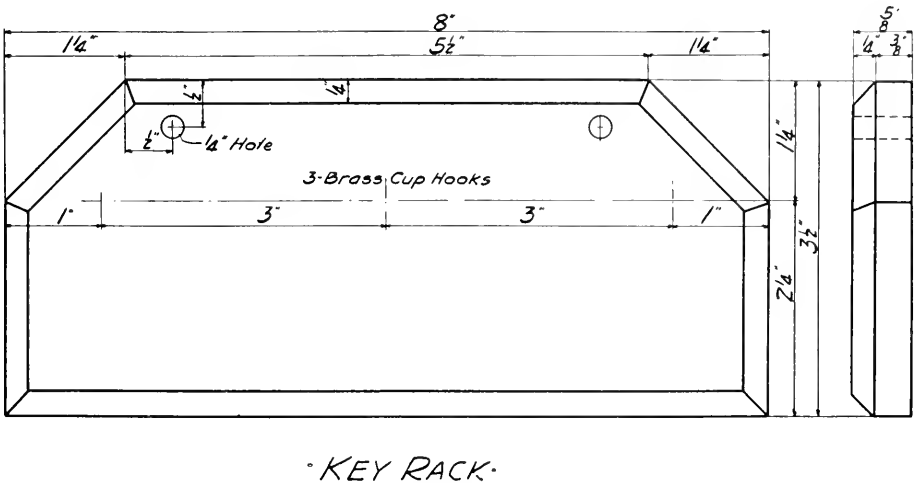
·BREAD BOARD·

PLATE 24



"KITCHEN UTENSIL RACK"

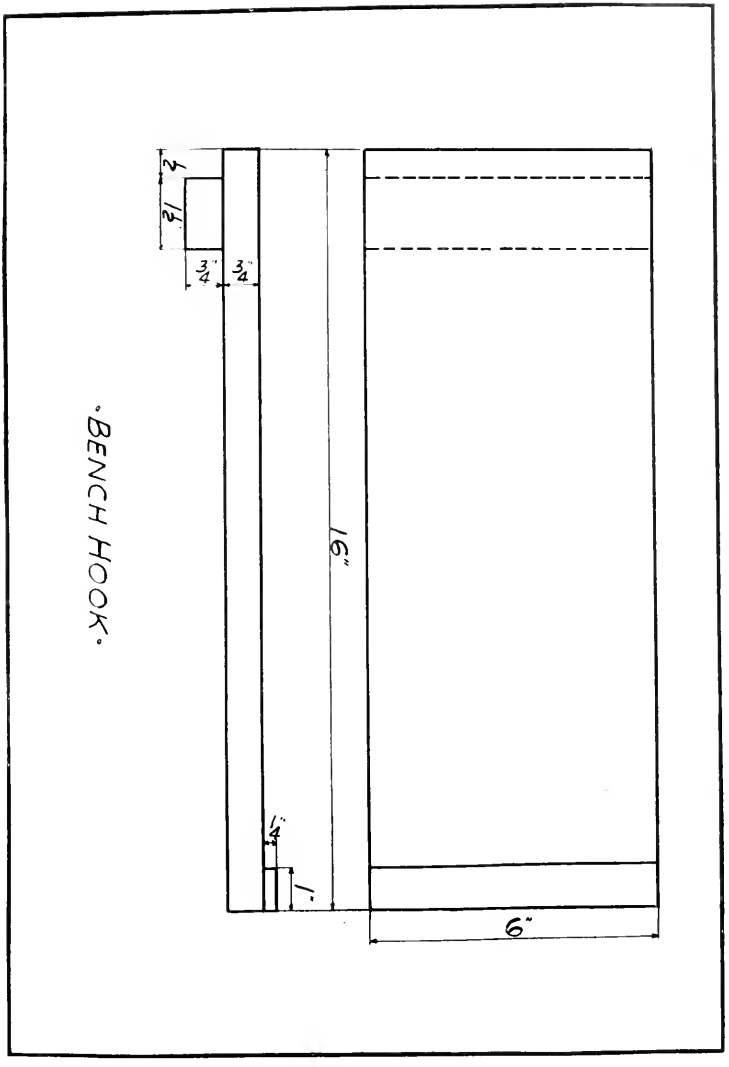
PLATE 25

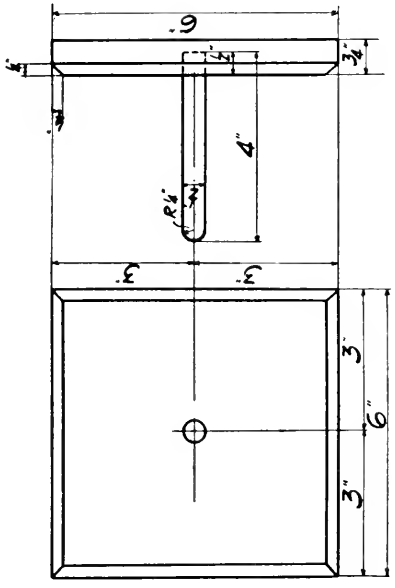


"KEY RACK"

PLATE 26

PLATE 27

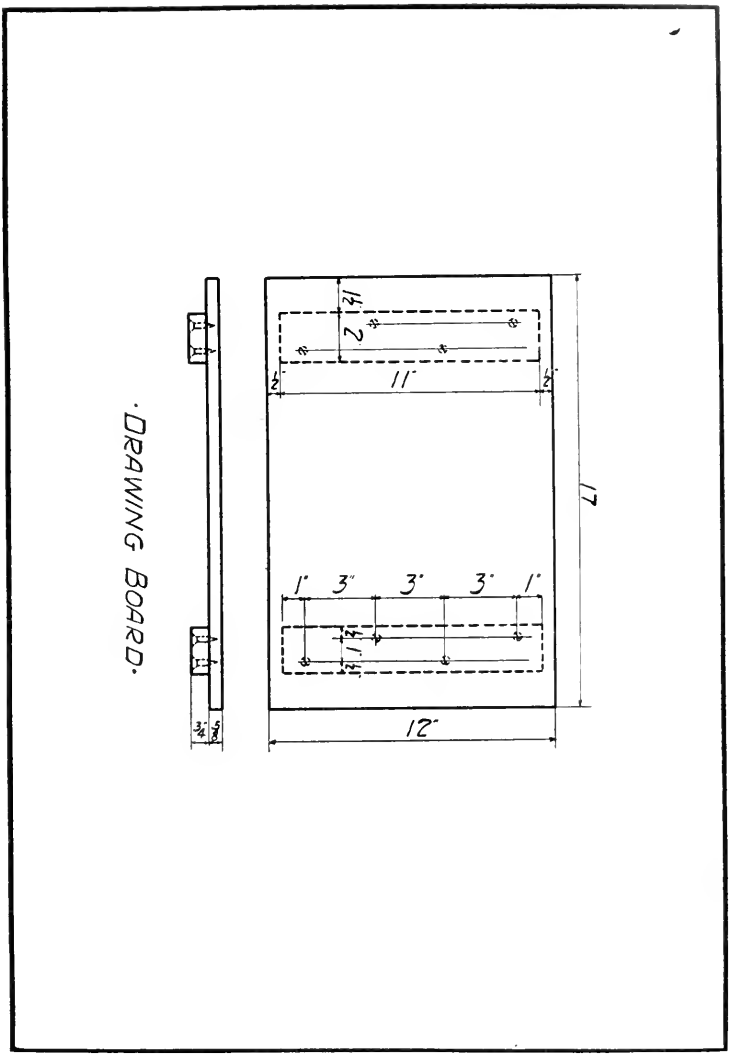


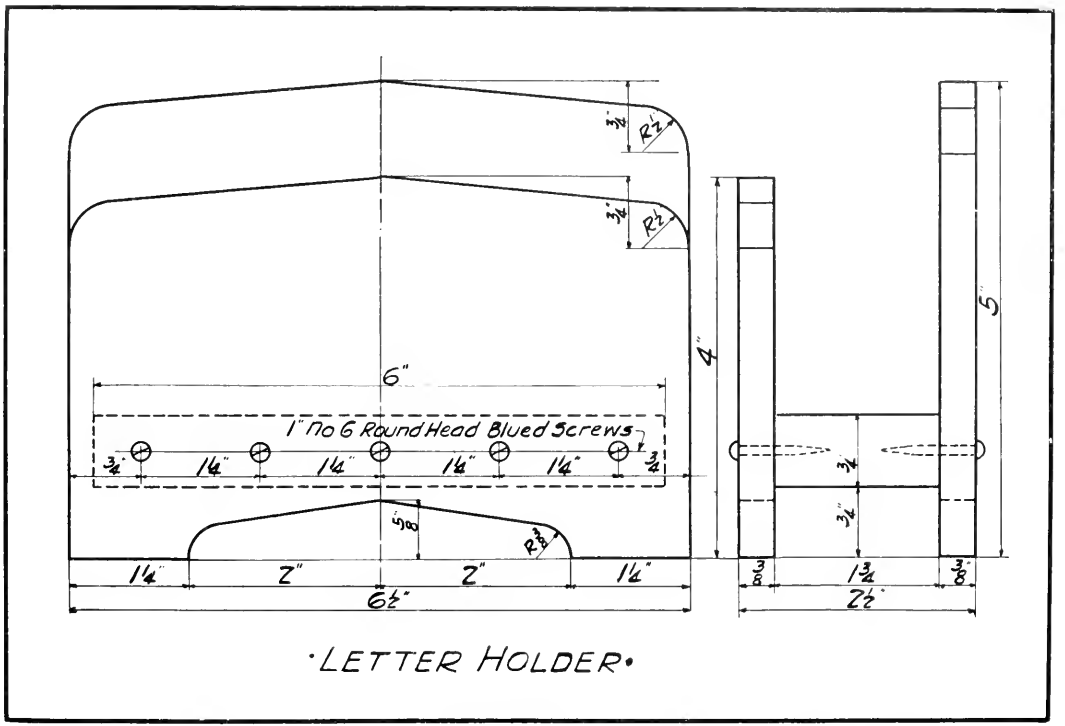


·RING TOSS·

PLATE 28

PLATE 29





·LETTER HOLDER·

PLATE 30

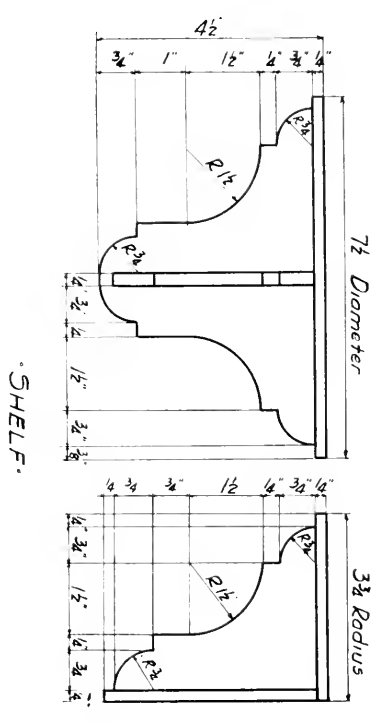

4½"
¾"
1"
1½"
¼"
⅜"
¼"
R 2¼
R 1½
R 2¼
7½ Diameter
¼
⅜
¼
1½"
¾"
⅛
SHELF.
¼
¾
¾"
1½
¼"
⅜"
¼"
R 2¼
R 1½
R 2¼
3⅜ Radius
¼"
¾"
1½"
¼
¾
⅛

PLATE 31

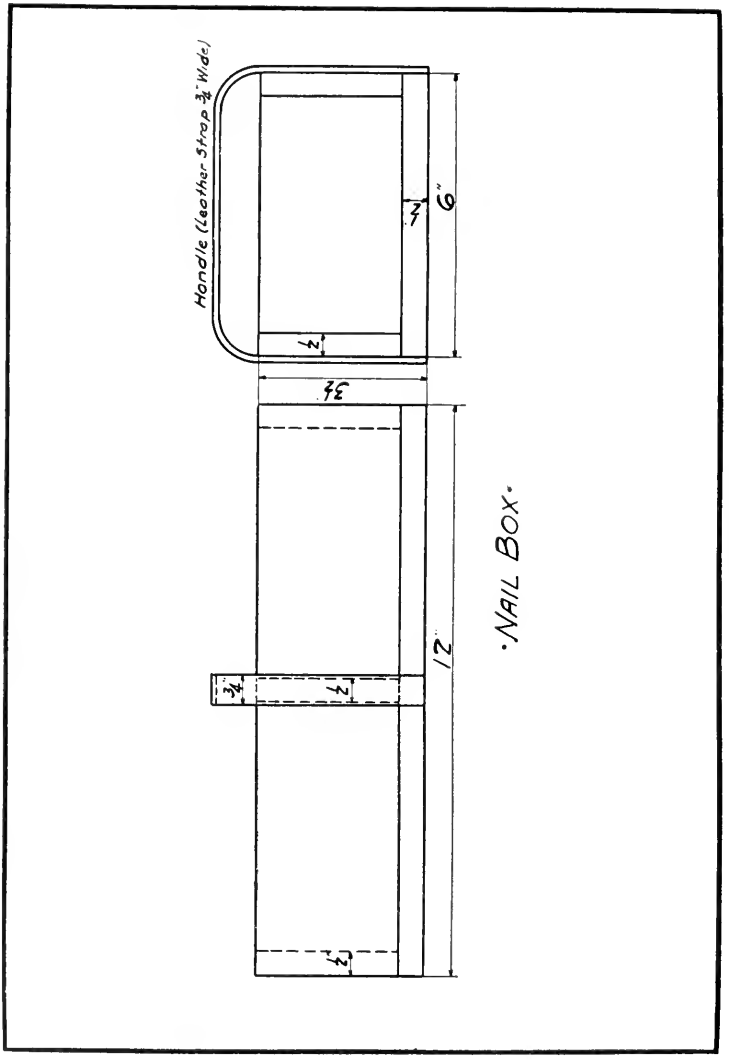
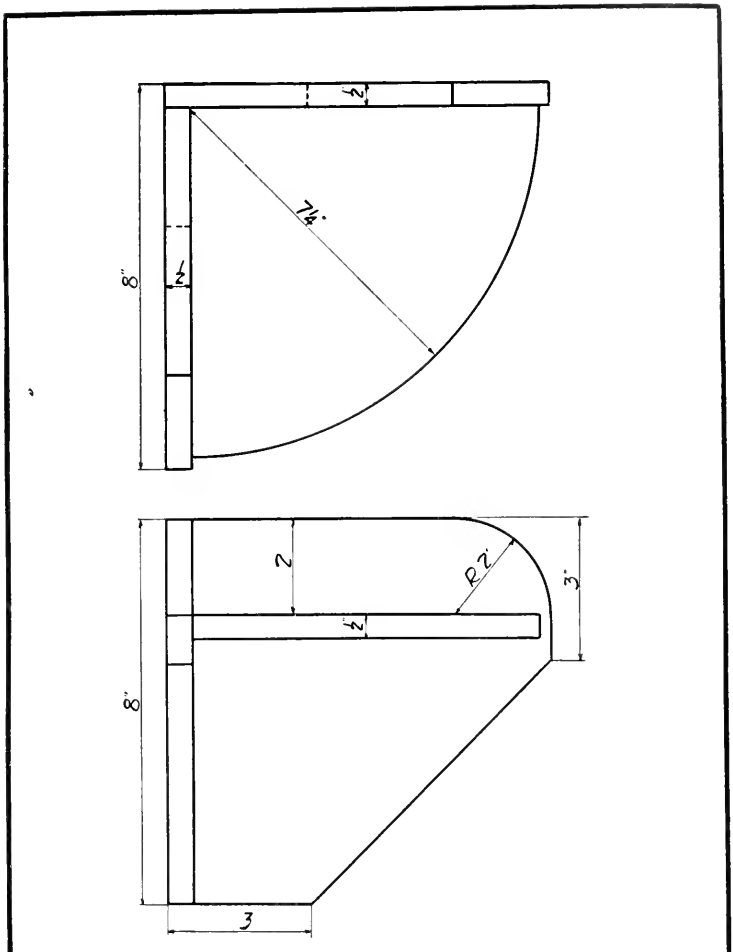
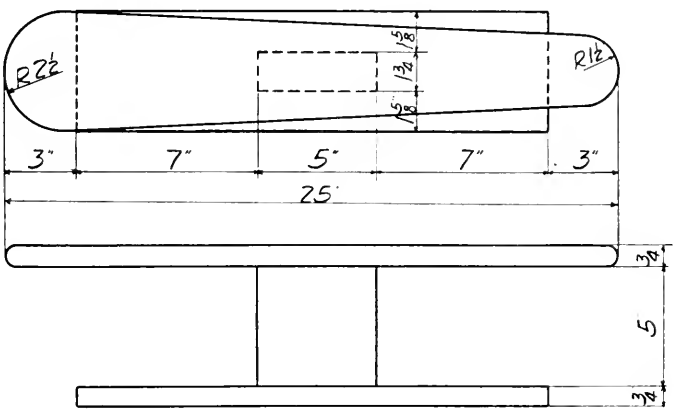


PLATE 32



CORNER SHELF.

PLATE 33



· SLEEVE BOARD ·

PLATE 34

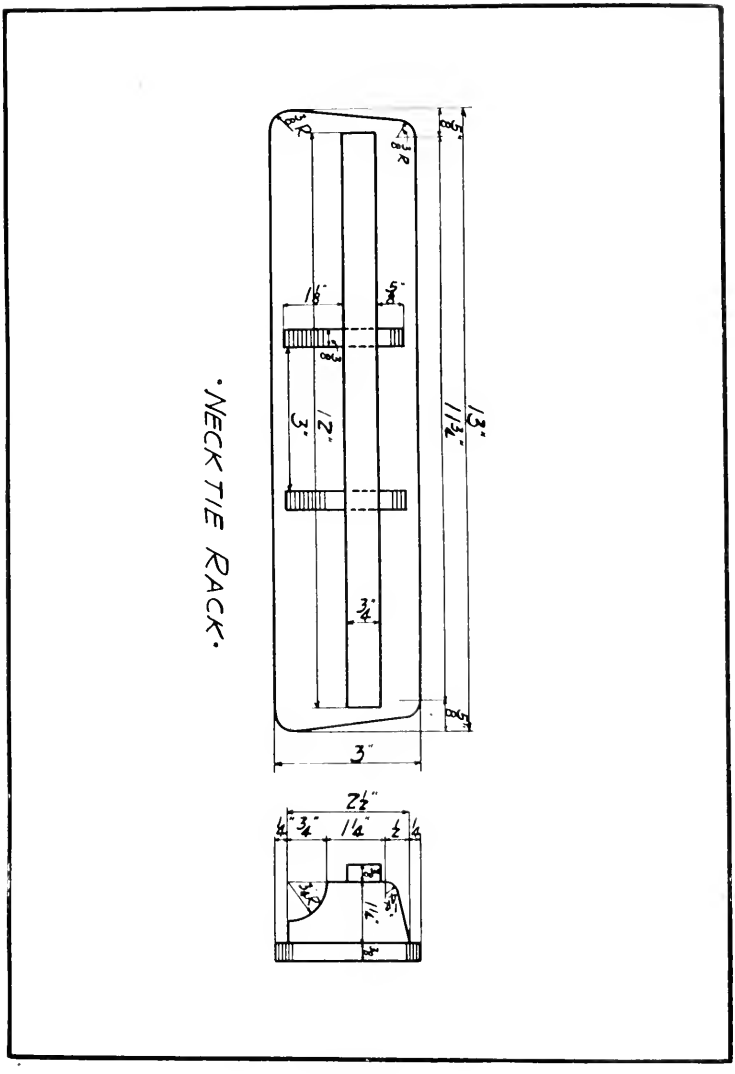
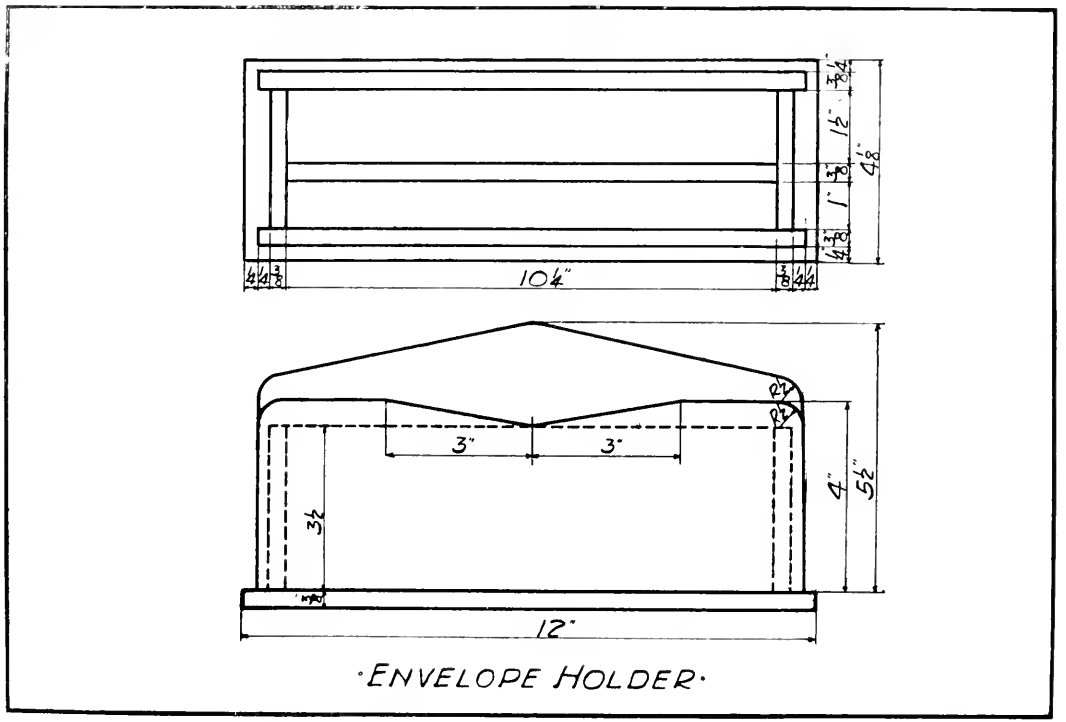


PLATE 35



·ENVELOPE HOLDER·

PLATE 36

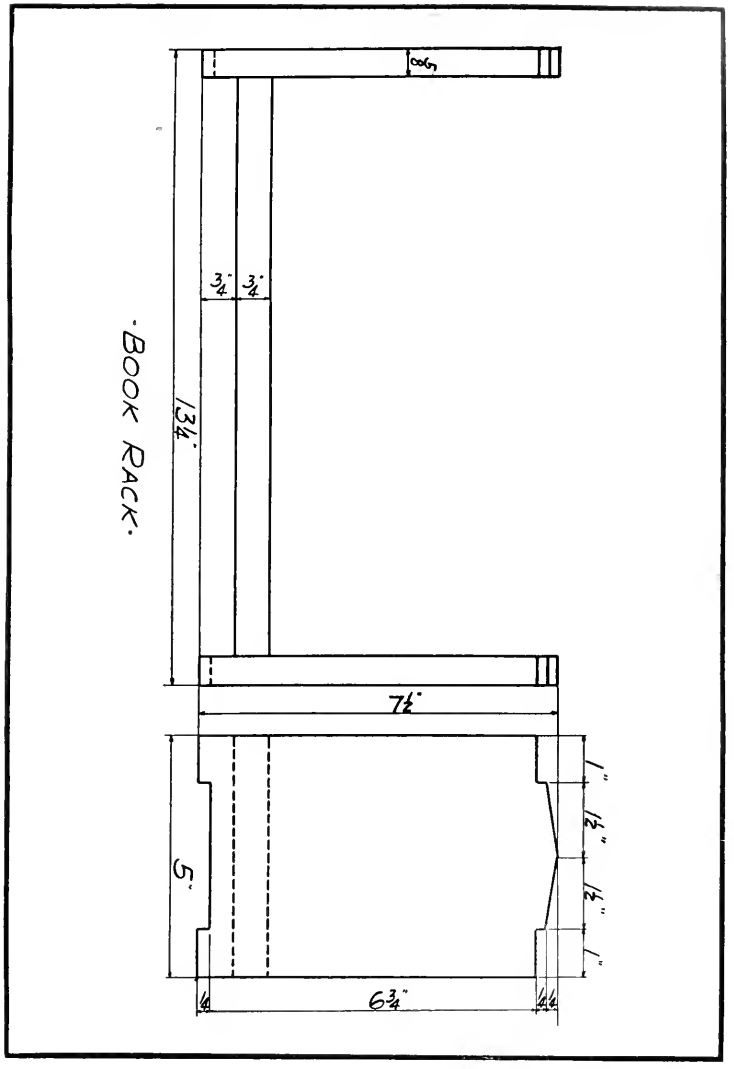
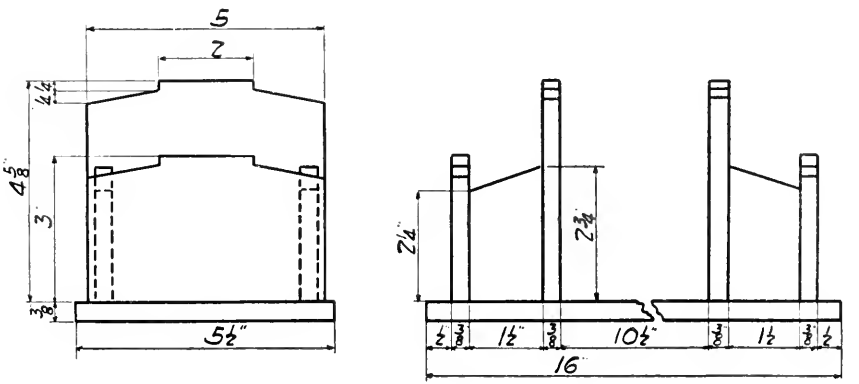
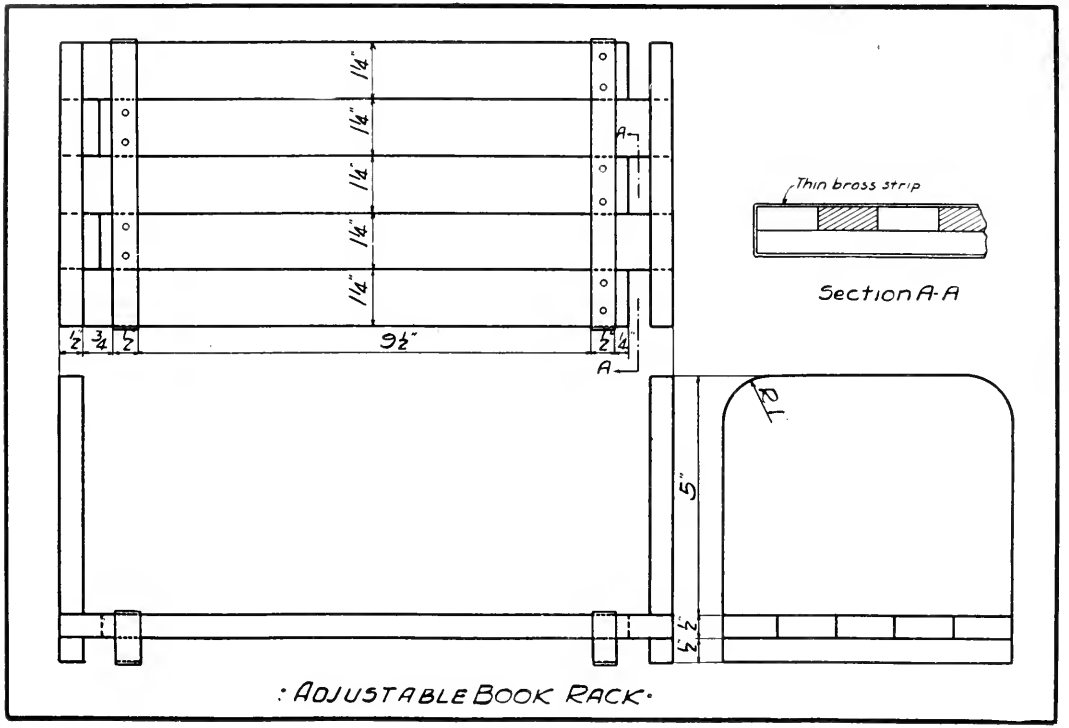


PLATE 37



·BOOK RACK·

PLATE 38



: ADJUSTABLE BOOK RACK :

PLATE 39

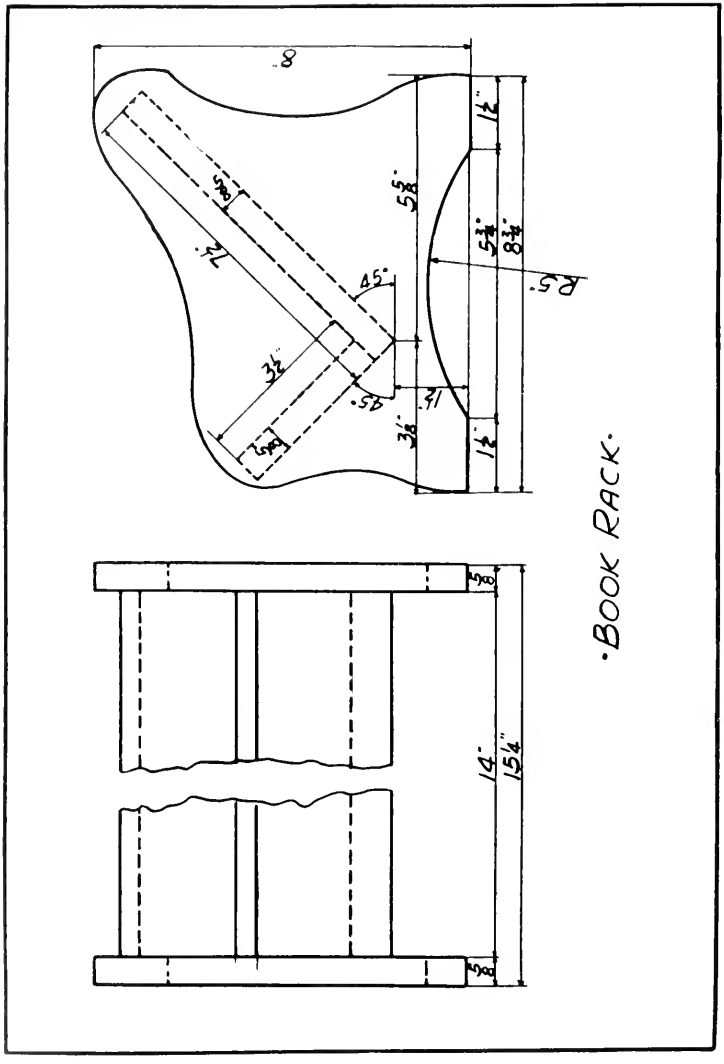
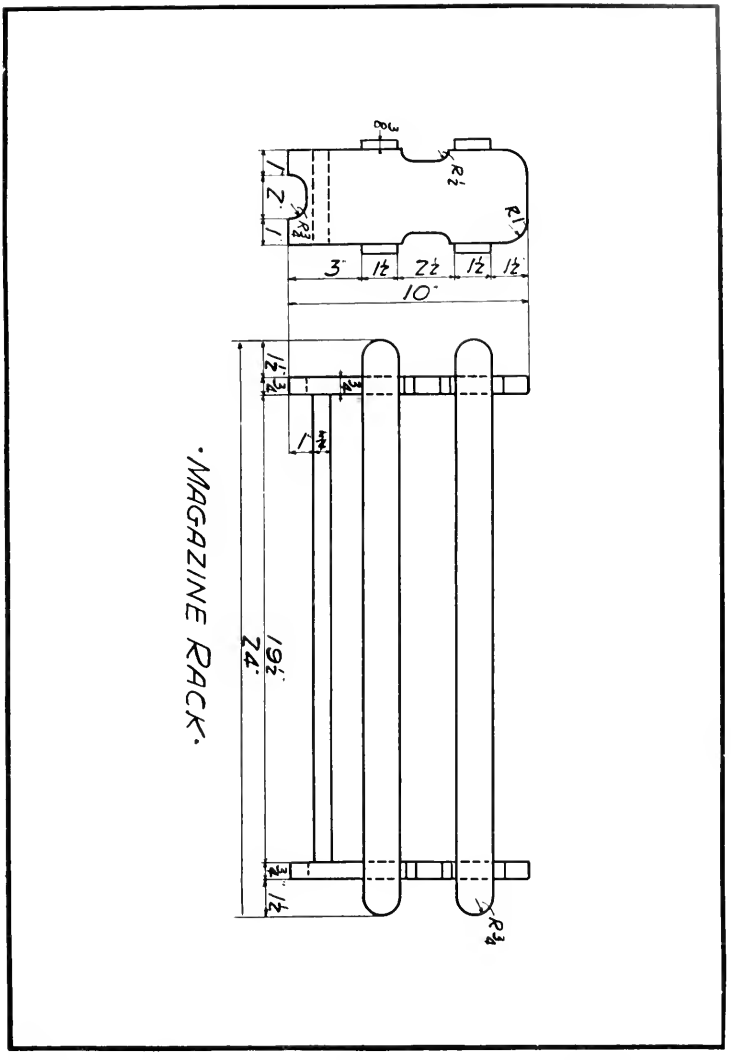


PLATE 40



MAGAZINE RACK.

PLATE 41

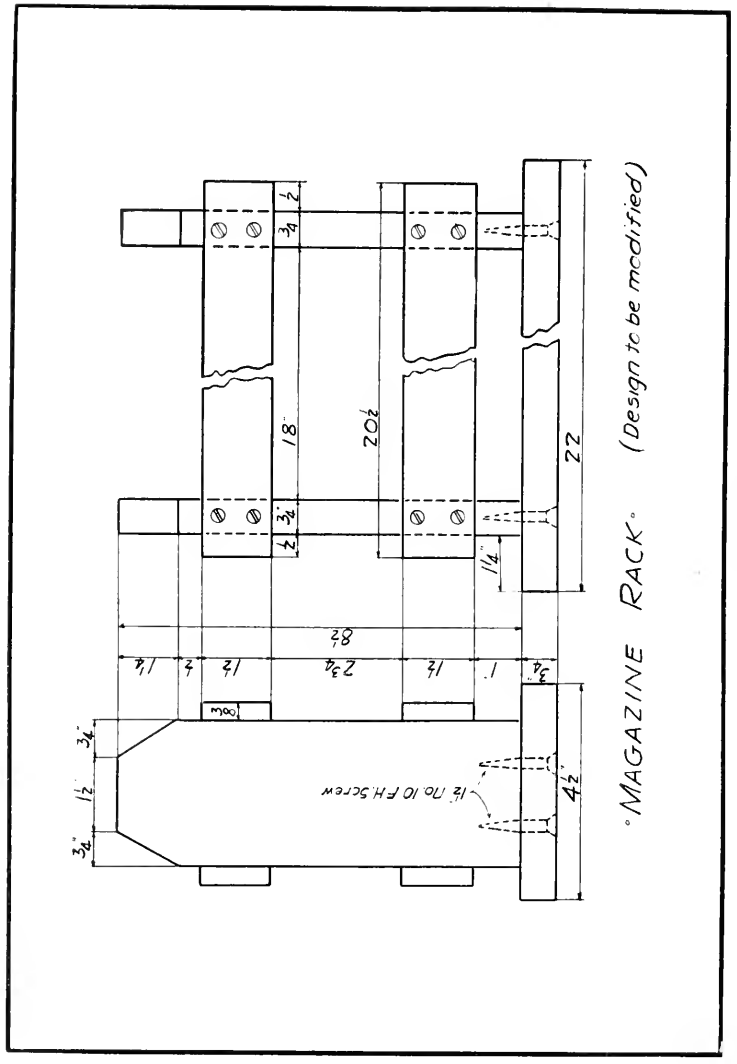
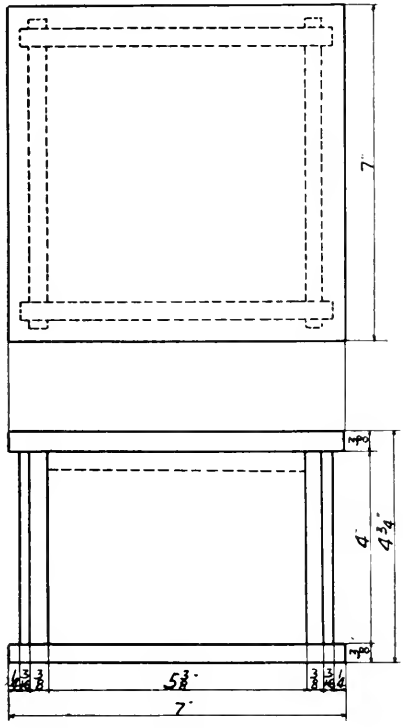

MAGAZINE RACK. (Design to be modified)
22
20½
18"
¾
½
1¼"
82
2¾
1½
1
¾
¼
3"
1½
3"
42"
12 No 10 F.H. Screw

PLATE 42



·HANDKERCHIEF BOX·

PLATE 43

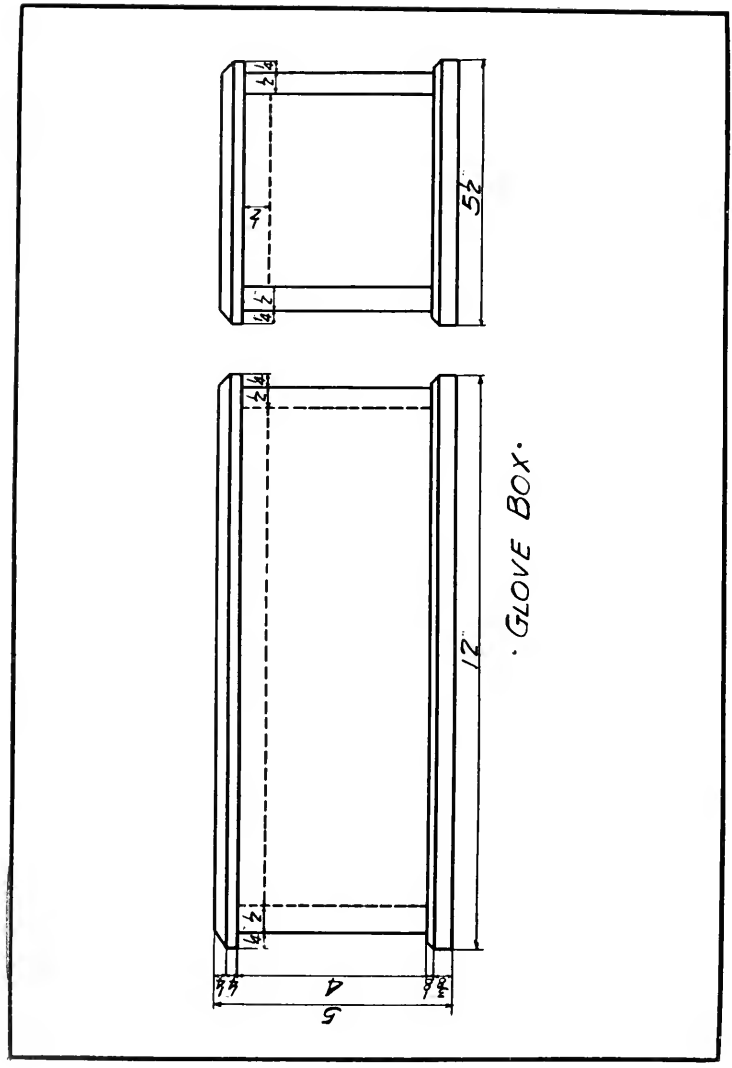


PLATE 44

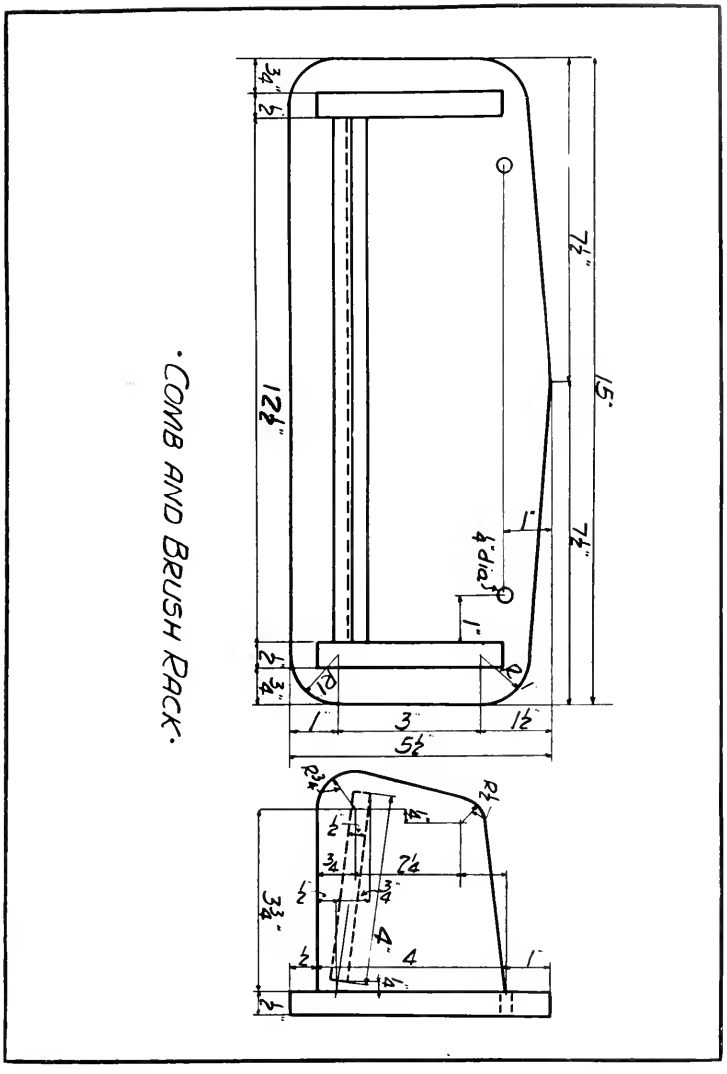
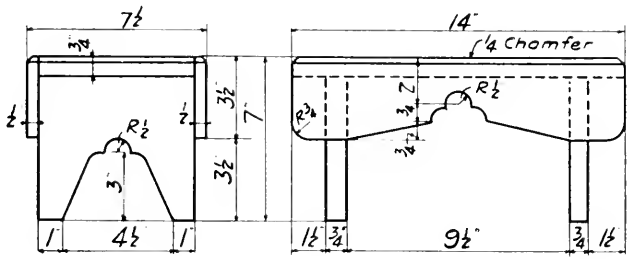

Comb and Brush Rack.
12½"
15"
7½"
7½"
4 dia.
1"
1"
¾"
½
1"
3
1½
5½
2¾
2¾
2½
4"
4
1"
3¾"

PLATE 45



·BENCH·

PLATE 46

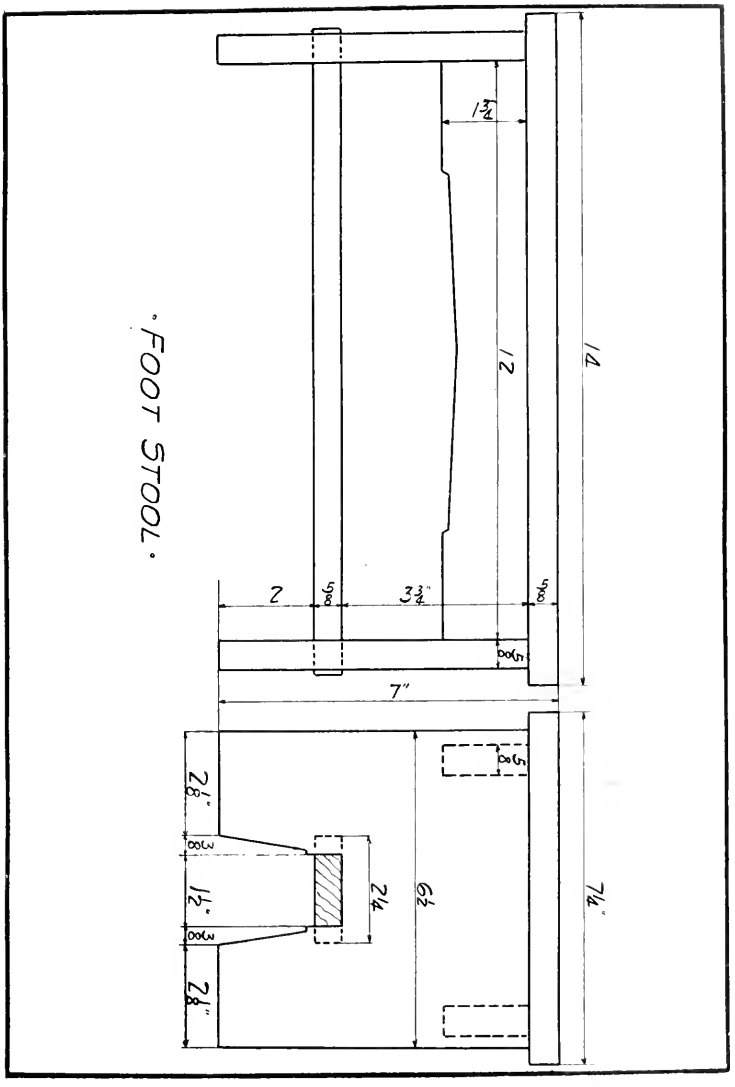
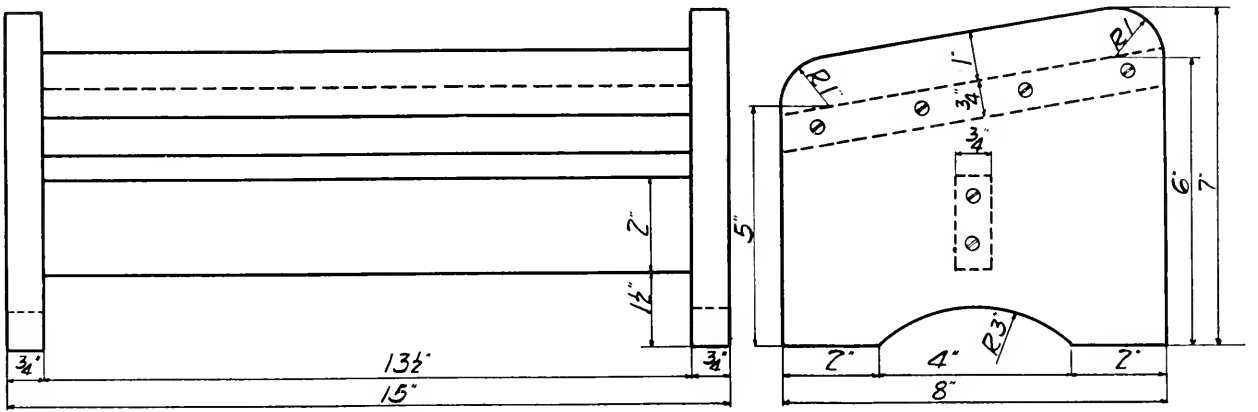
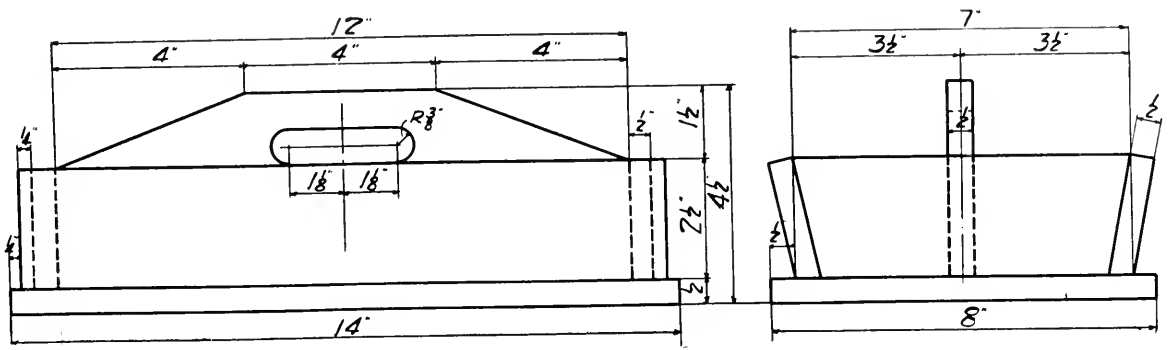


PLATE 47



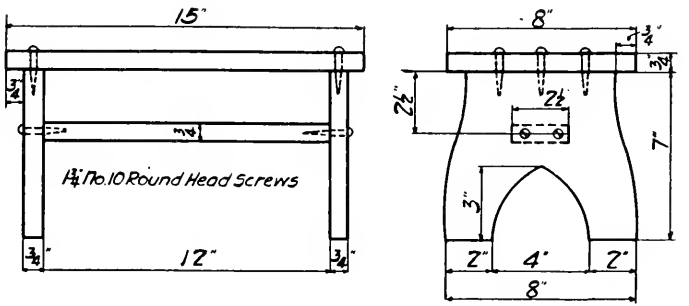
·FOOT STOOL·

PLATE 48



· KNIFE AND FORK BOX ·

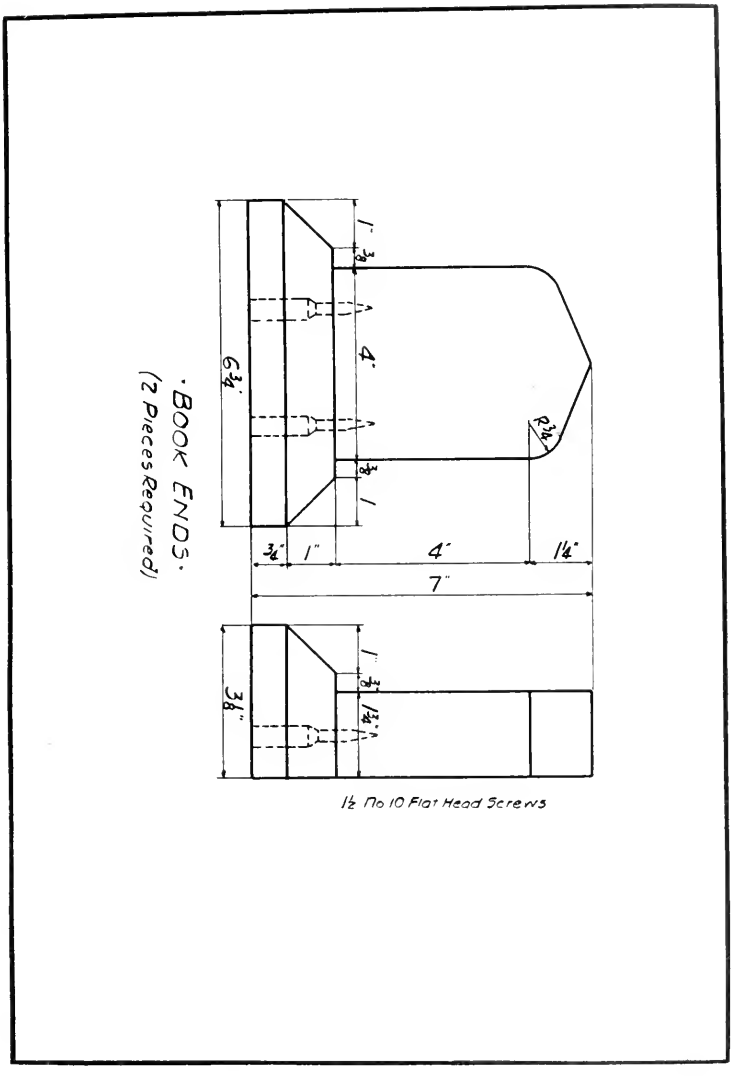
PLATE 49



·FOOT STOOL·

PLATE 50

PLATE 51


BOOK ENDS.
(2 Pieces Required)
1"
3/4
4"
6 3/4"
3/4
1
3/4"
1"
4"
1/4"
7"
3/4"
1"
3/4
1/4"
1/2 No 10 Flat Head Screws

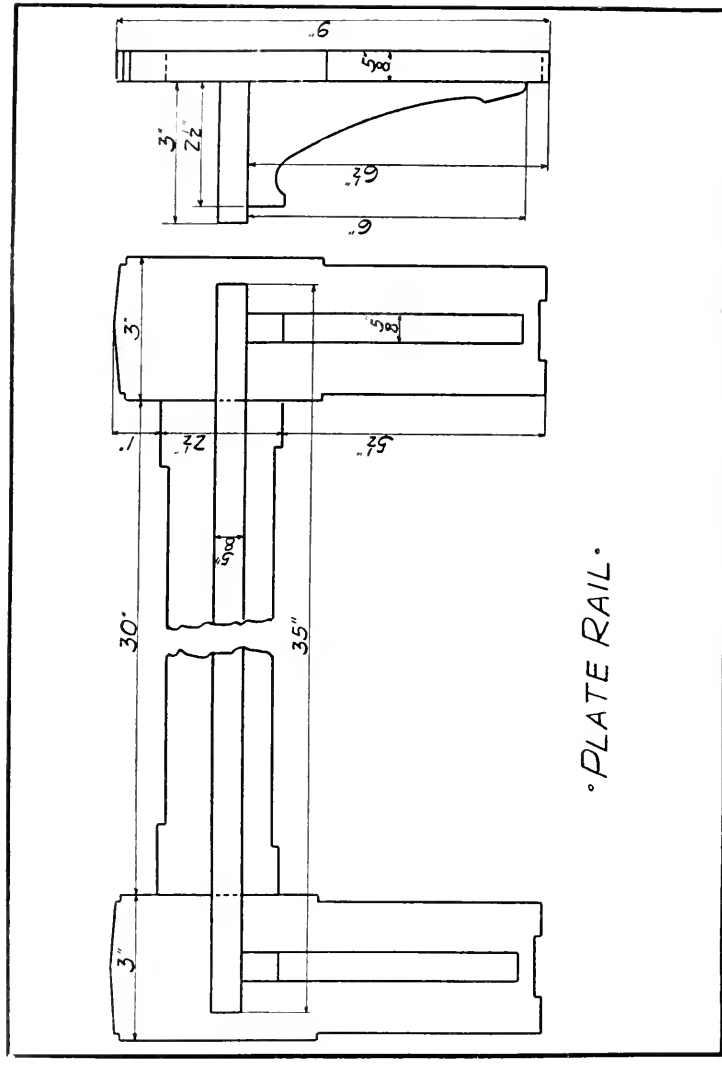


PLATE 52

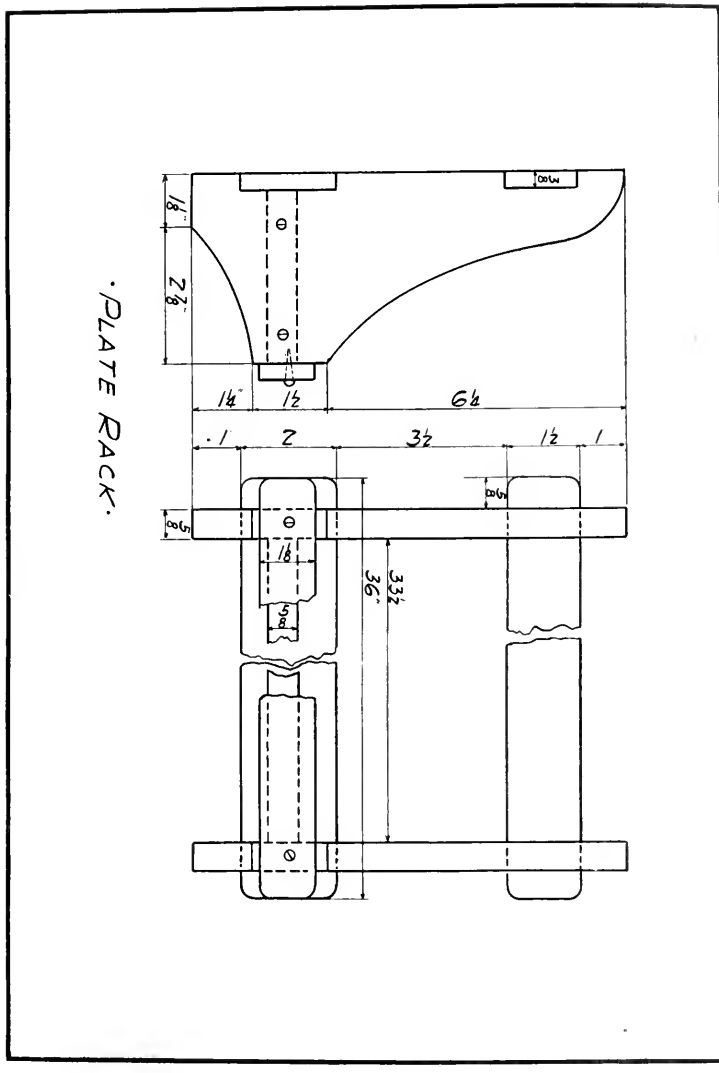
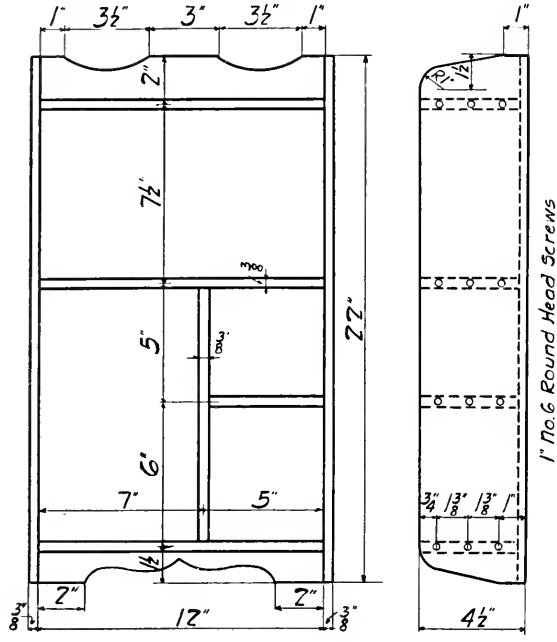
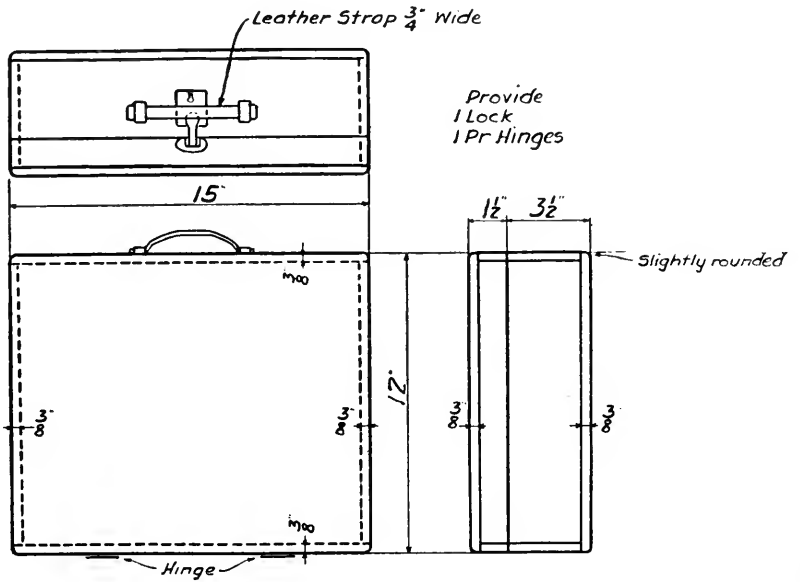


PLATE 53



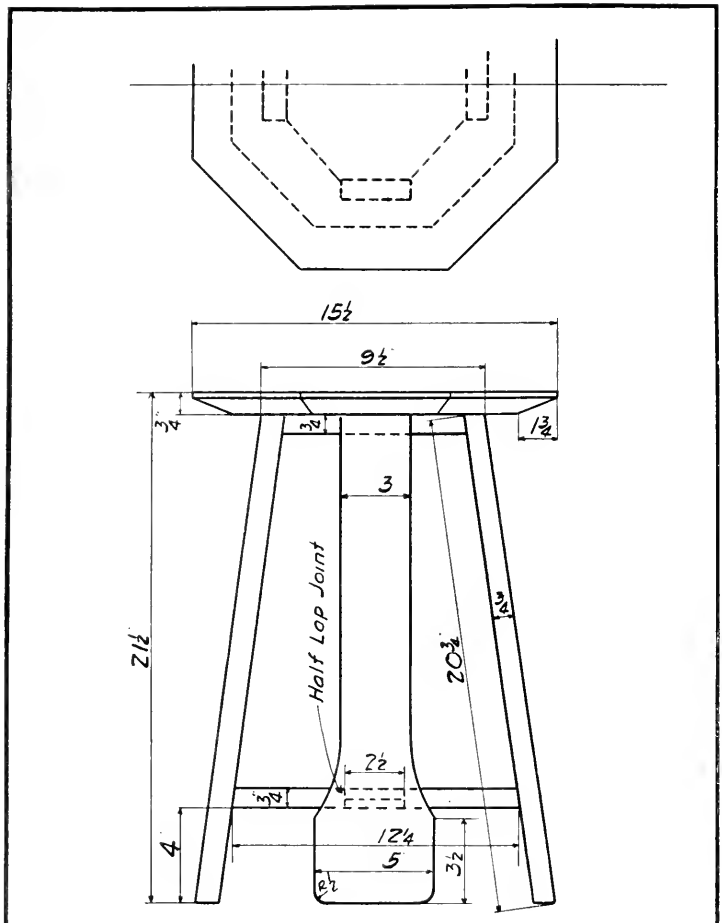
·MEDICINE CABINET·

PLATE 54



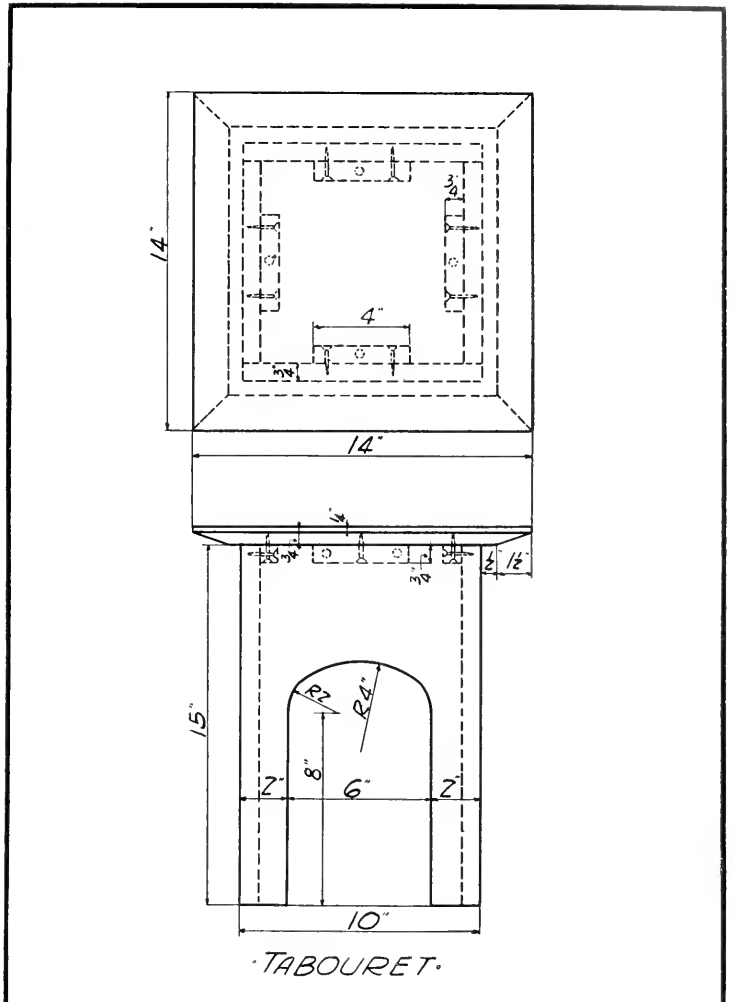
·CARRYING CASE·

PLATE 55



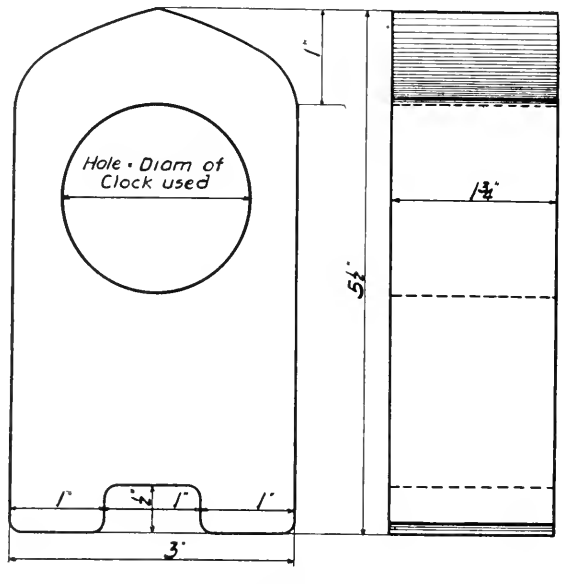
·TABOURET·

PLATE 56



TABOURET.

PLATE 57



CLOCK

PLATE 58

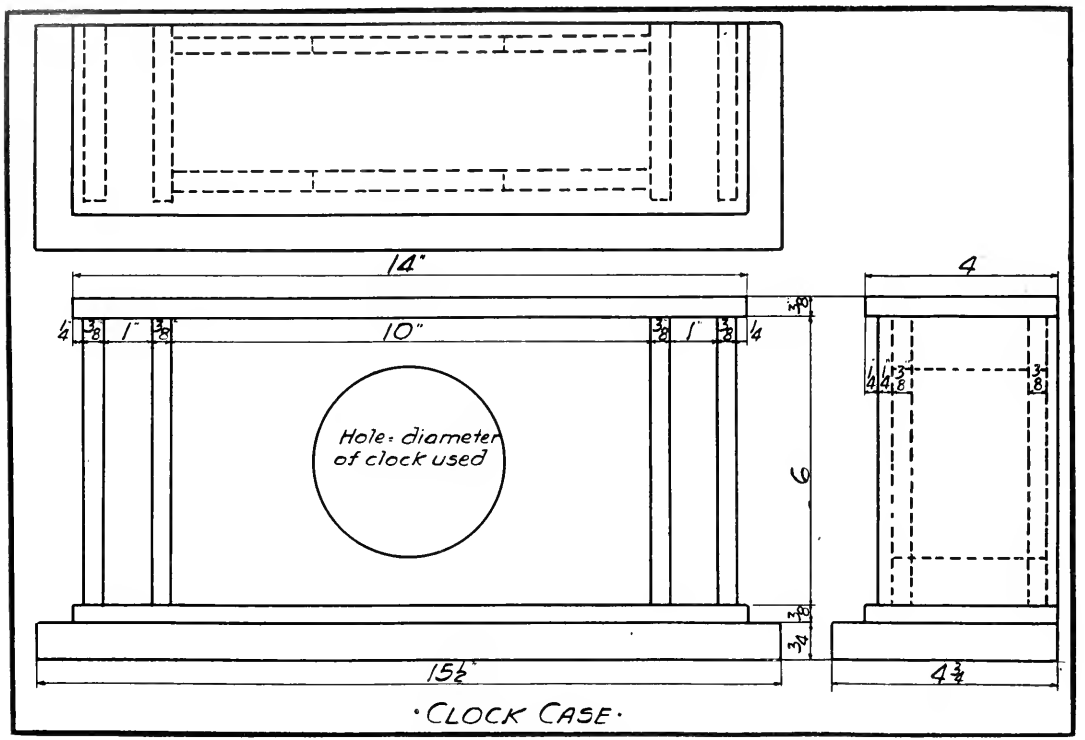
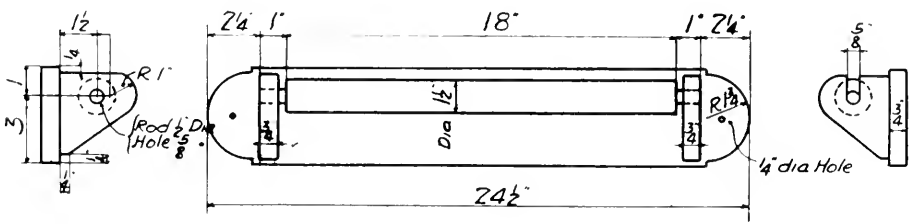
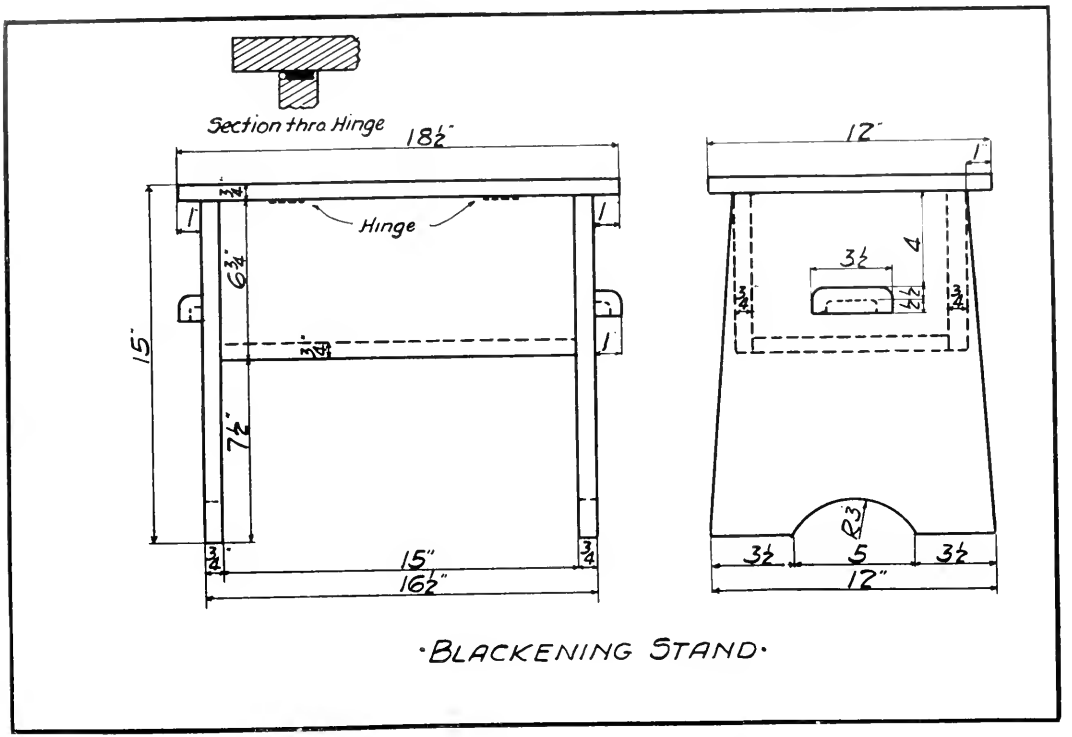


PLATE 59



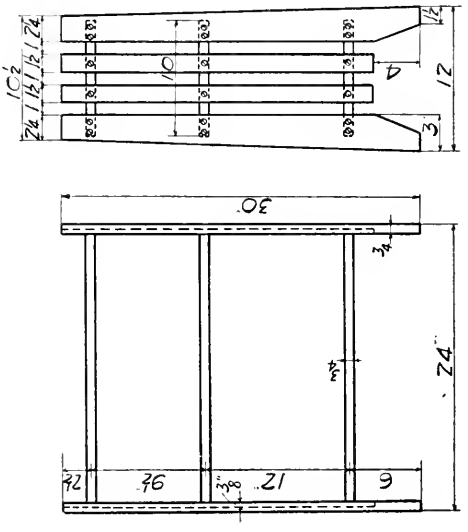
·TOWEL RACK·

PLATE 60



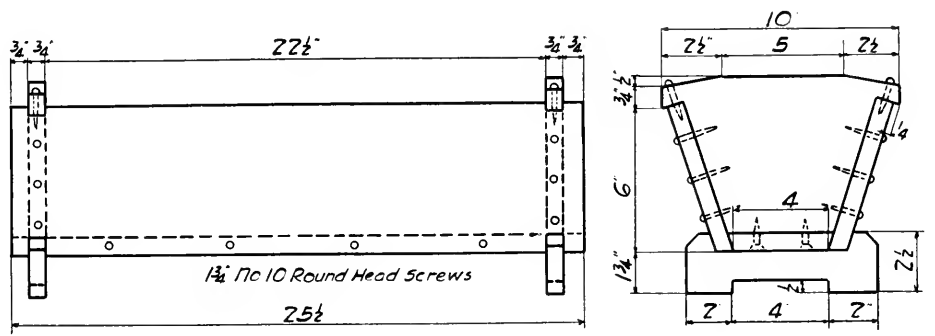
·BLACKENING STAND·

PLATE 61



BOOK STAND.

PLATE 62



· WINDOW BOX ·

PLATE 63

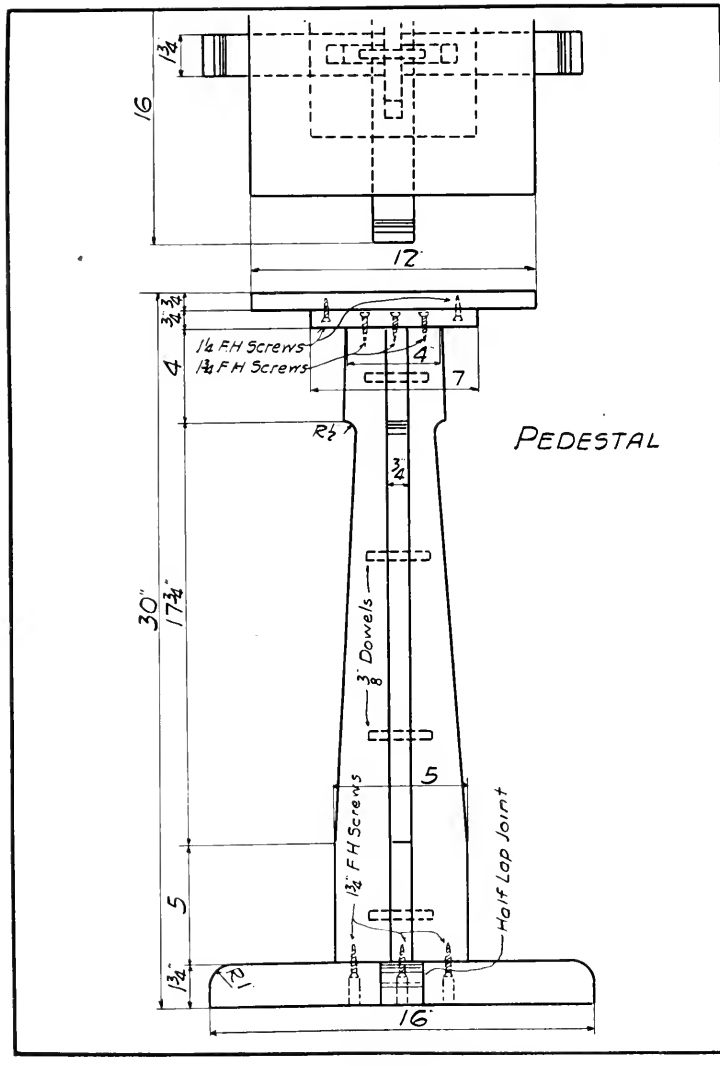
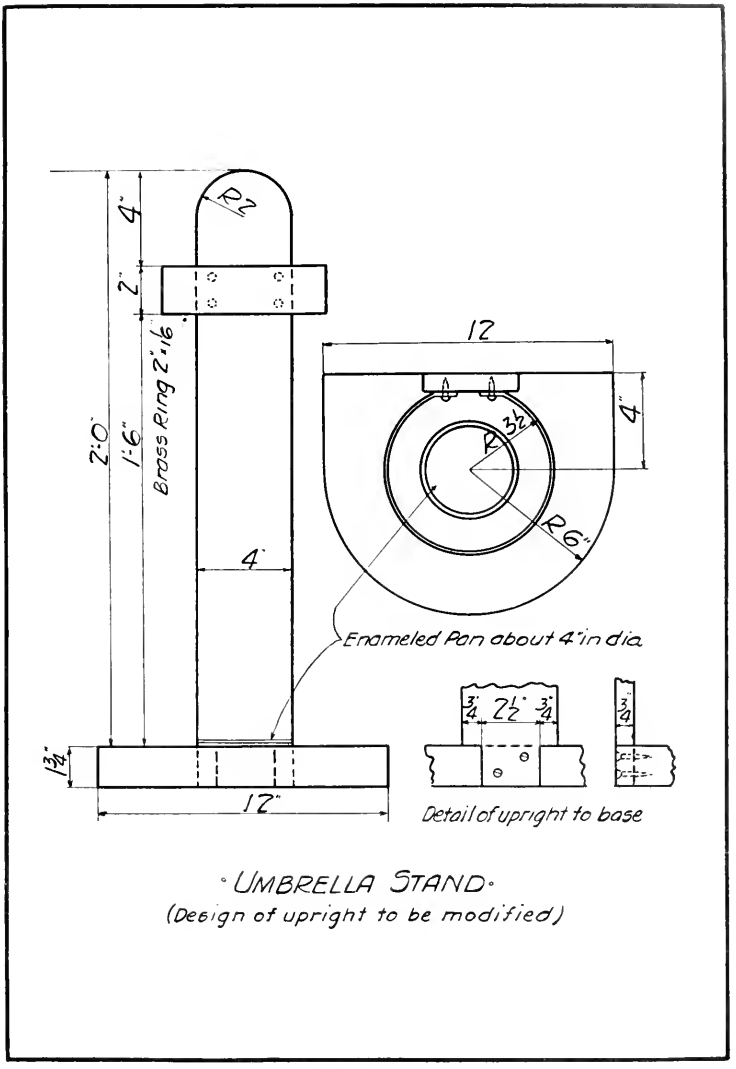

PEDESTAL
16
12
1¼
3¼
4
7
1/2 F.H Screws
1 3/4 F.H Screws
R½
2¼
30"
17¾"
3/8" Dowels
5
1¾" F.H Screws
Half Lap Joint
12
16

PLATE 64



UMBRELLA STAND.
(Design of upright to be modified)

PLATE 65

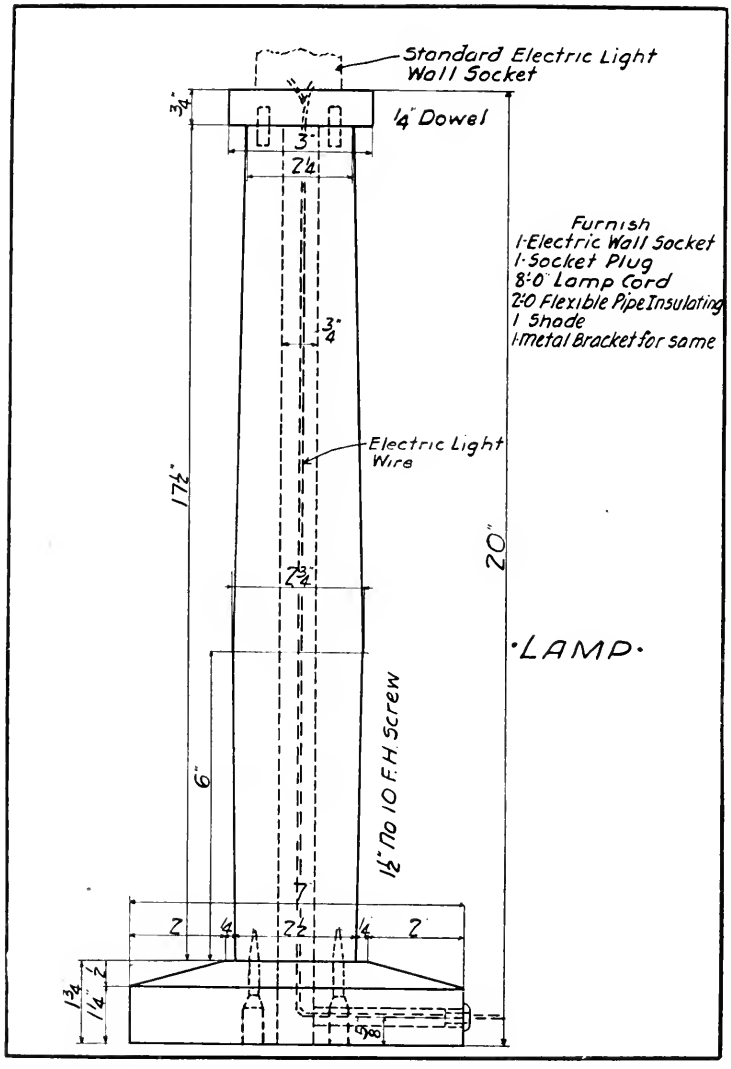

Standard Electric Light
Wall Socket
¼" Dowel
3"
2¼"
¾"
Furnish
1-Electric Wall Socket
1-Socket Plug
8'-0" Lamp Cord
2'-0 Flexible Pipe Insulating
1 Shade
1-metal Bracket for same
Electric Light
Wire
17½"
20"
2¾"
·LAMP·
6"
1½" No 10 F.H. Screw
2
¼
2½
¼
2
1¾"
1¼"
½
⅝

PLATE 66

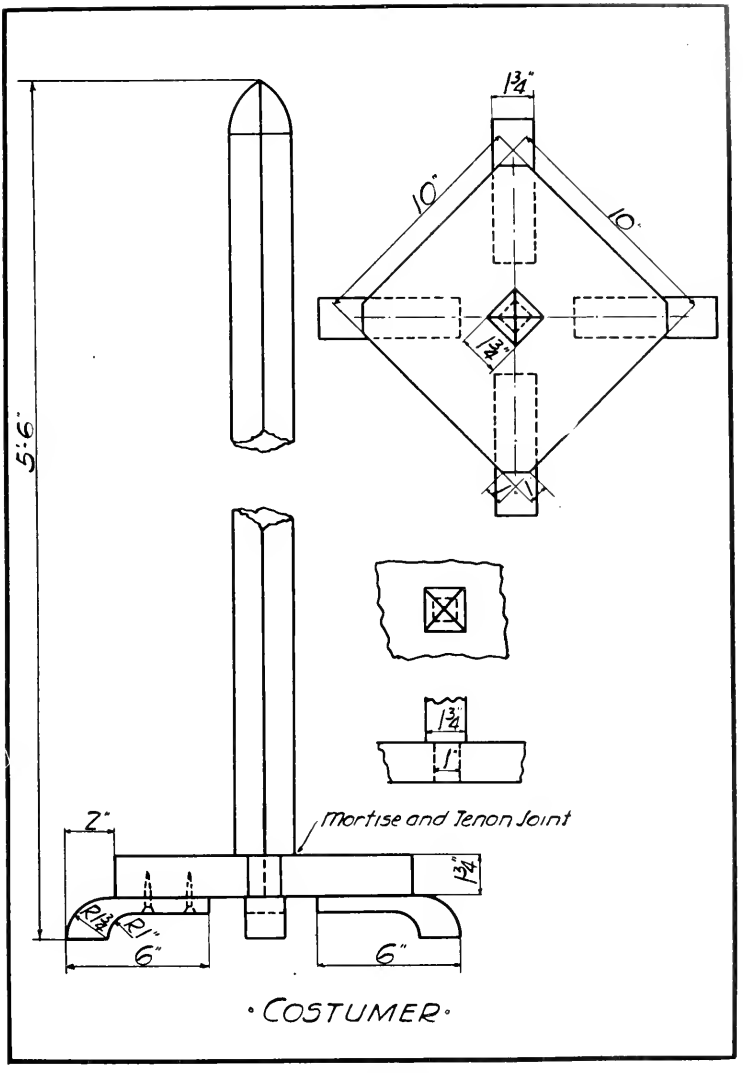
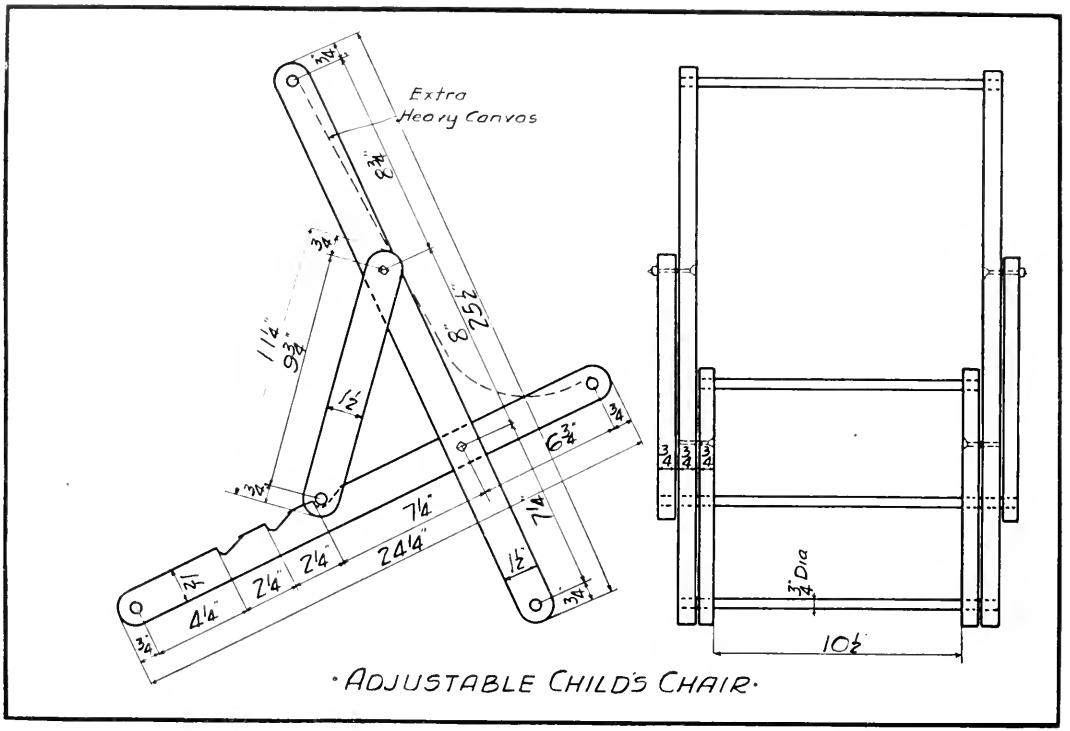

5'-6"
1¾"
10"
10"
1¾"
1¾"
1"
2"
Mortise and Tenon Joint
1¾"
R¾"
R1"
6"
6"
·COSTUMER·

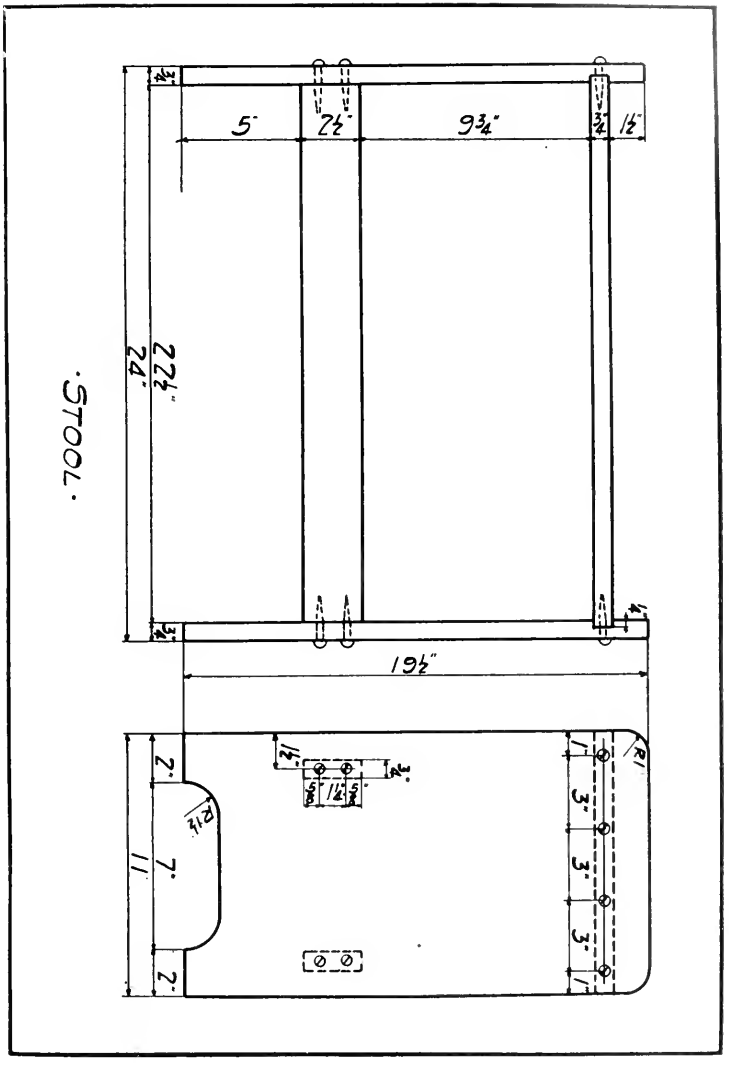
PLATE 67

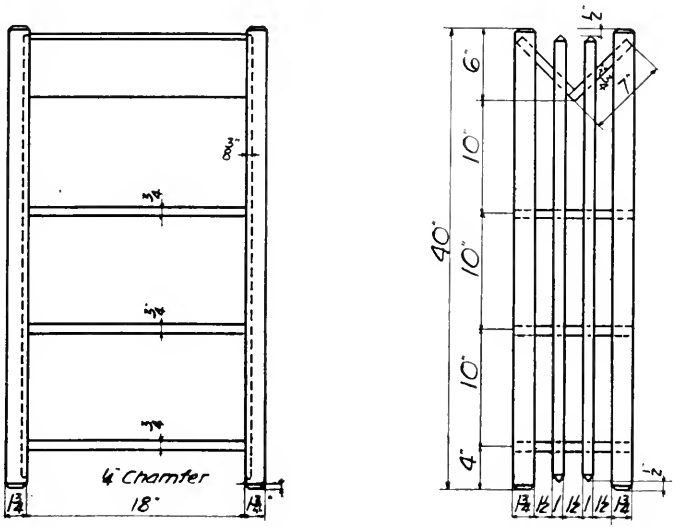


ADJUSTABLE CHILD'S CHAIR.

PLATE 68

PLATE 69





·MAGAZINE AND BOOK RACK·

PLATE 70

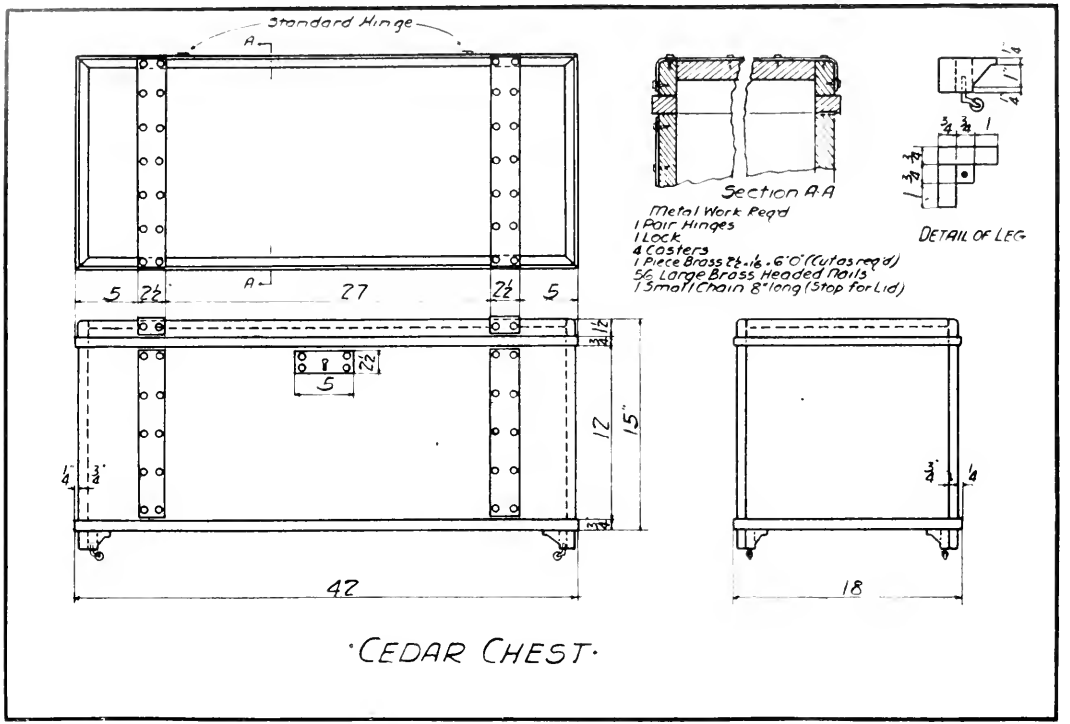

Standard Hinge
A
A
5
2½
27
2½
5
8
5
2½
3½
12
15"
¼
¾
¾
47
18
Section A-A
Metal Work Reqd
1 Pair Hinges
1 Lock
4 Casters
1 Piece Brass ¾ × ⅛ - 6'-0" (Cut as reqd)
56 Large Brass Headed Nails
1 Small Chain 8" long (Stop for Lid)
DETAIL OF LEG
·CEDAR CHEST·

PLATE 71

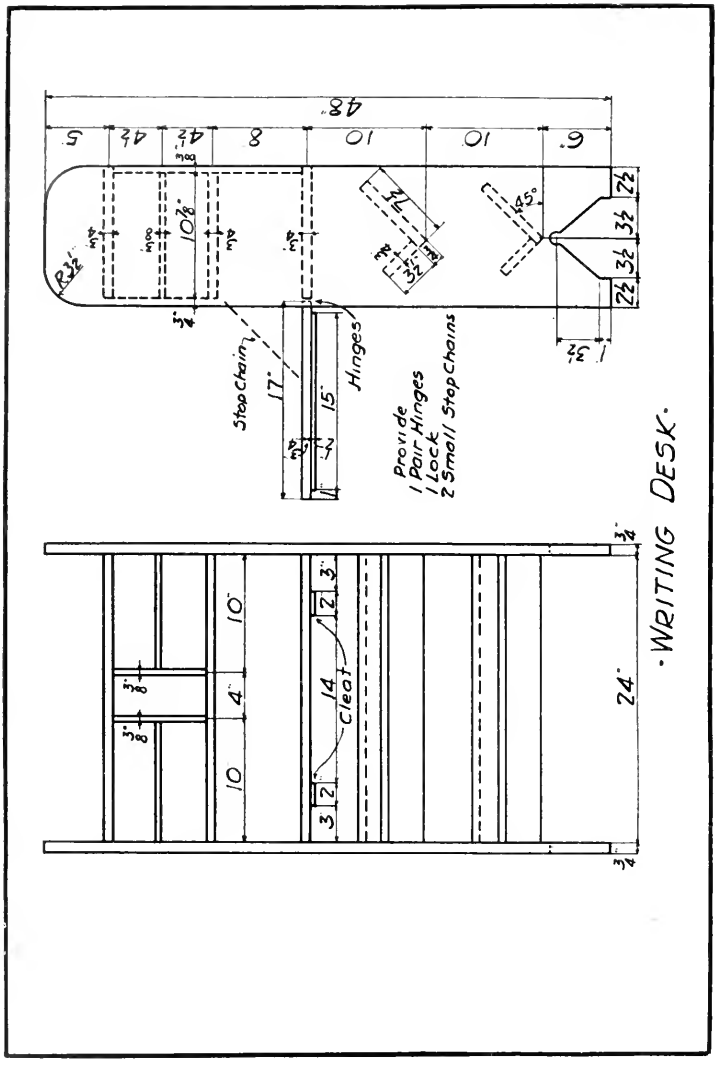

WRITING DESK.
48"
6"
10"
10"
8"
4½"
4½"
5"
R22"
10½"
45°
7½"
3½"
2½"
3½"
2½"
3½"
Stop Chain
17"
15"
Hinges
Provide
1 Pair Hinges
1 Lock
2 Small Stop Chains
24"
14"
Cleat
10"
4"
3"
2"
¾"

PLATE 72

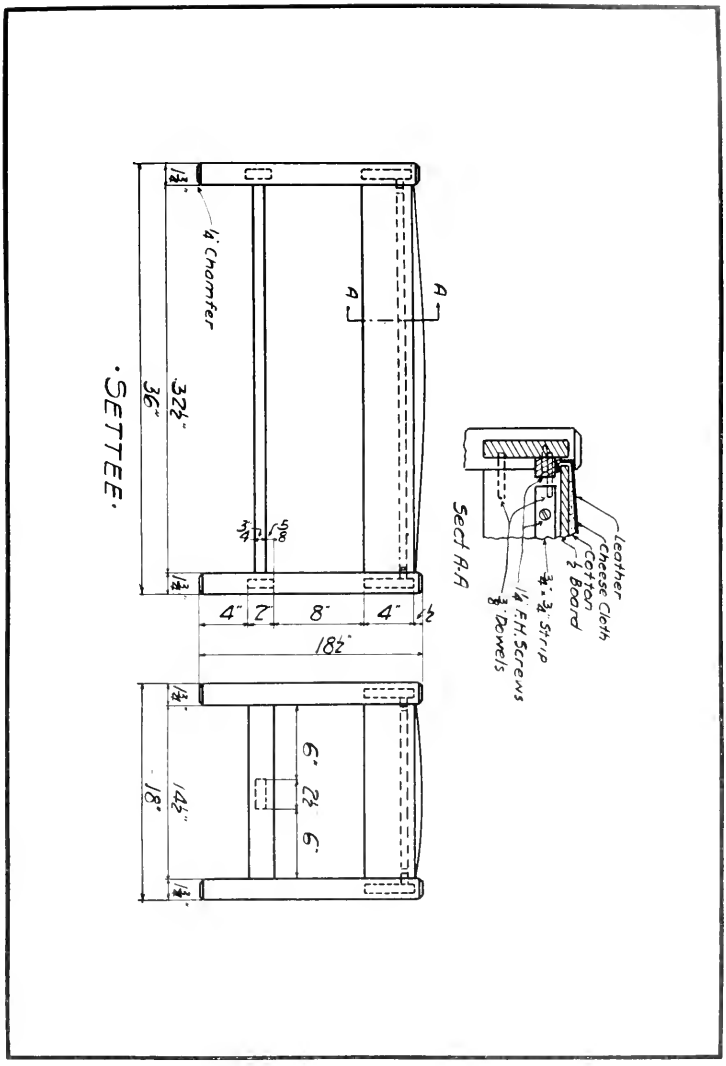

SETTEE.
36"
32½"
¼" Chamfer
A
A
4"
7"
8"
4"
½
182"
18"
14½"
6"
2½
6"
Sect A-A
Leather
Cheese Cloth
Cotton
½ Board
¾ × ¾ Strip
¼ F.H. Screws
⅜ Dowels

PLATE 73

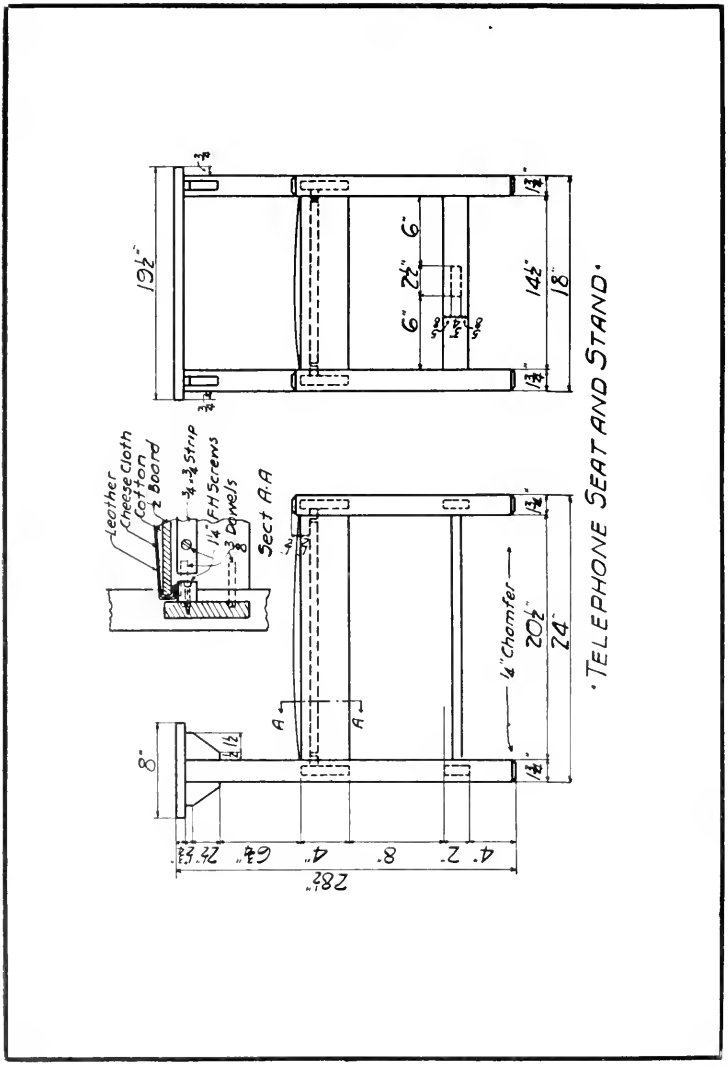

'TELEPHONE SEAT AND STAND'
Leather
Cheese Cloth
Cotton
2 Board
Sect A.A
4 Panels
8 Panels
4" Chamfer
20½"
24"
14"
18"
6"
6"
8"
4'. 2". 8". 4". 6¾". 2¾".
28½"

PLATE 74

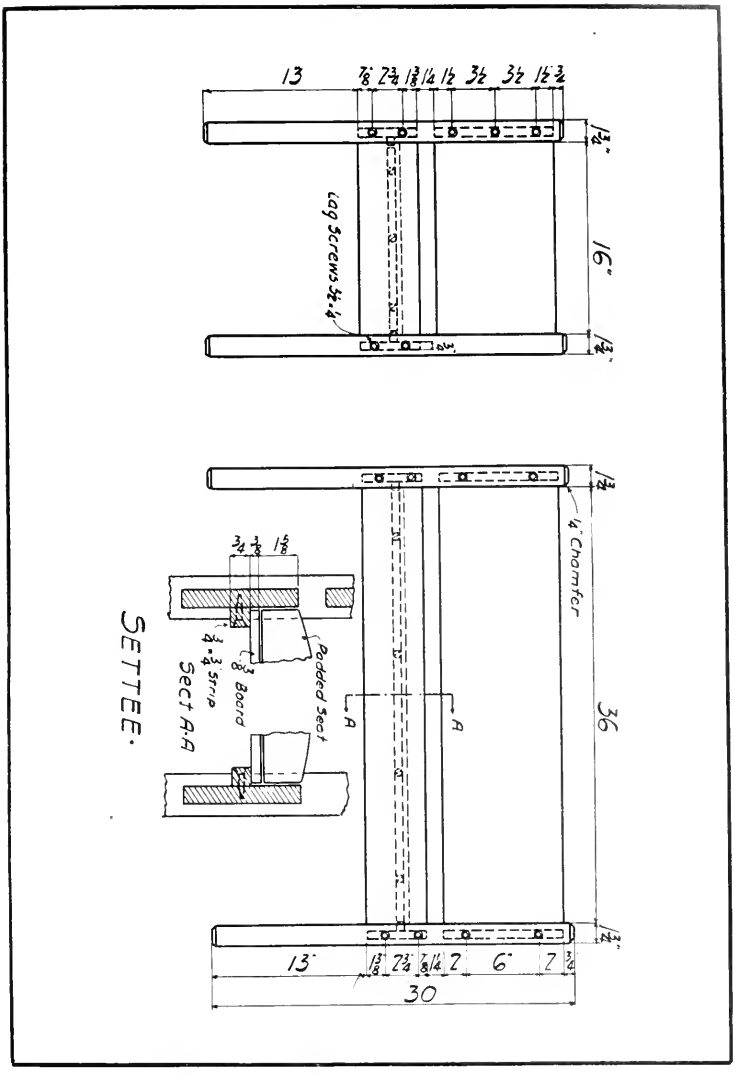

13
7/8 2 3/4 1 3/8 1/4 1/2 3 1/2 3 1/2 1 1/2 3/4
1 3/4"
Lag Screws 3/4 dia
16"
1 3/4"
1 3/4
4" Chamfer
3/4 1/8 1 5/8
3/4 - 3/4 Strip
3/8 Board
Padded Seat
Sect A-A
A
A
36
SETTEE.
1 3/4"
13"
1 3/8 2 3/4 1/4 2 6" 2
30

PLATE 75

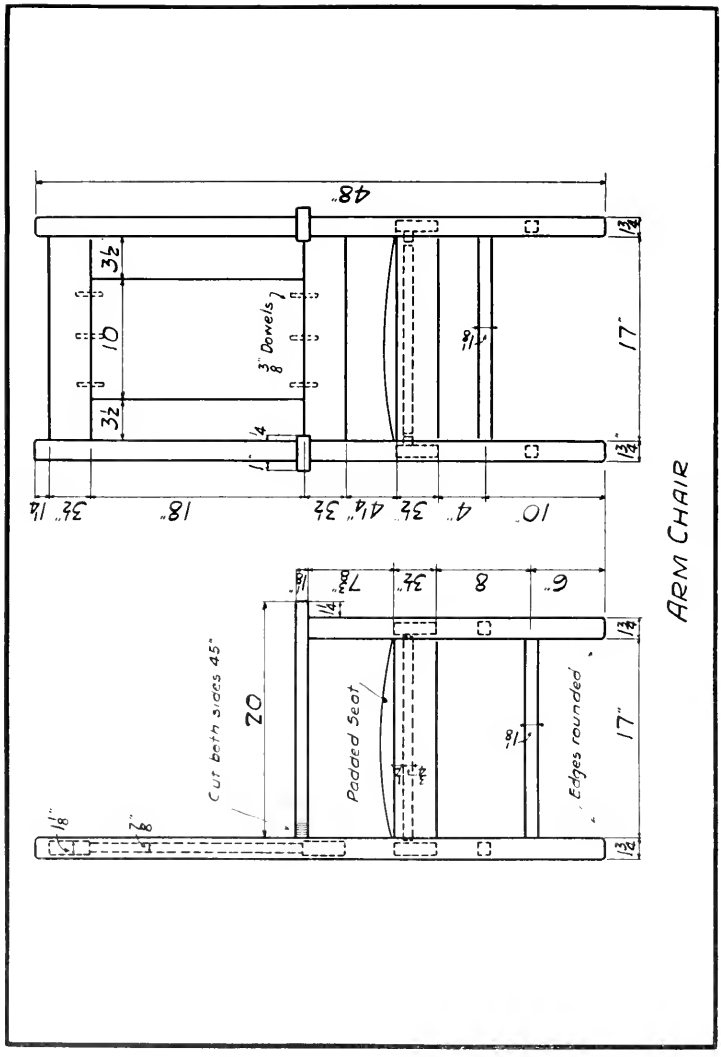
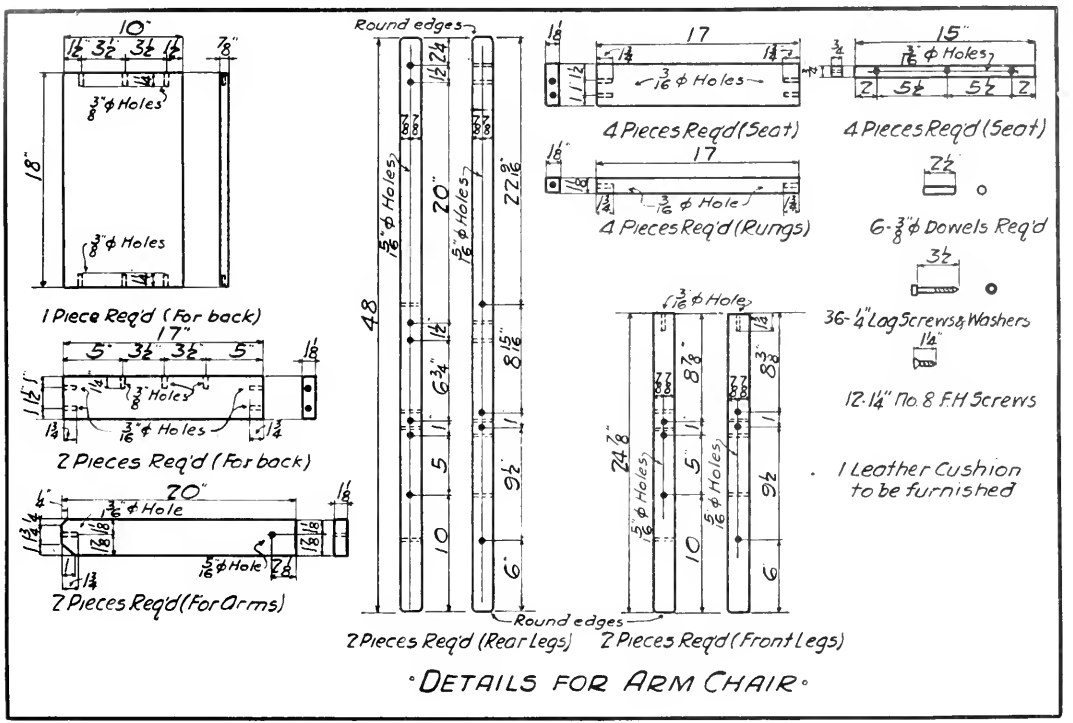
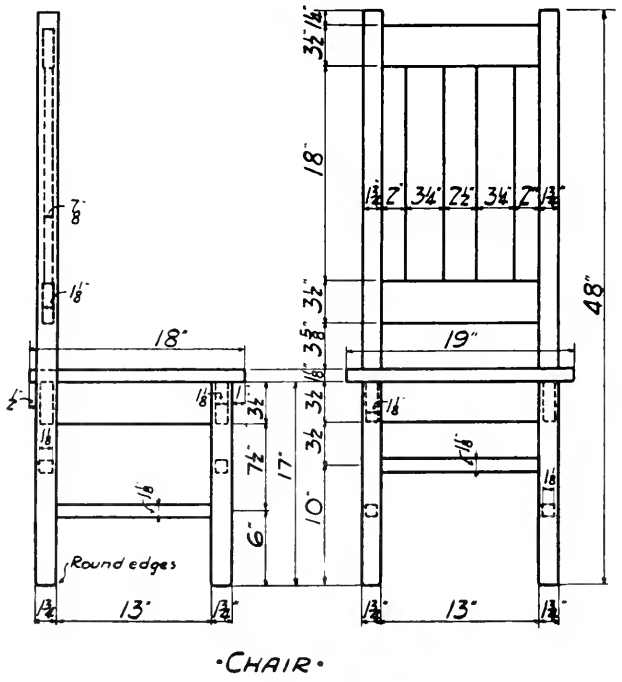

ARM CHAIR
48"
17"
3/8" Dowels
10"
4"
6"
8
20
Padded Seat
Edges rounded
Cut both sides 45°

PLATE 76



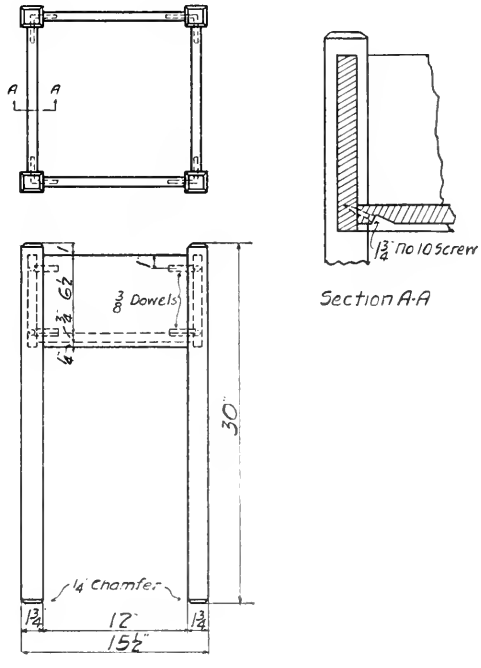
·DETAILS FOR ARM CHAIR·

PLATE 77



·CHAIR·

PLATE 78



FERN STAND

PLATE 79

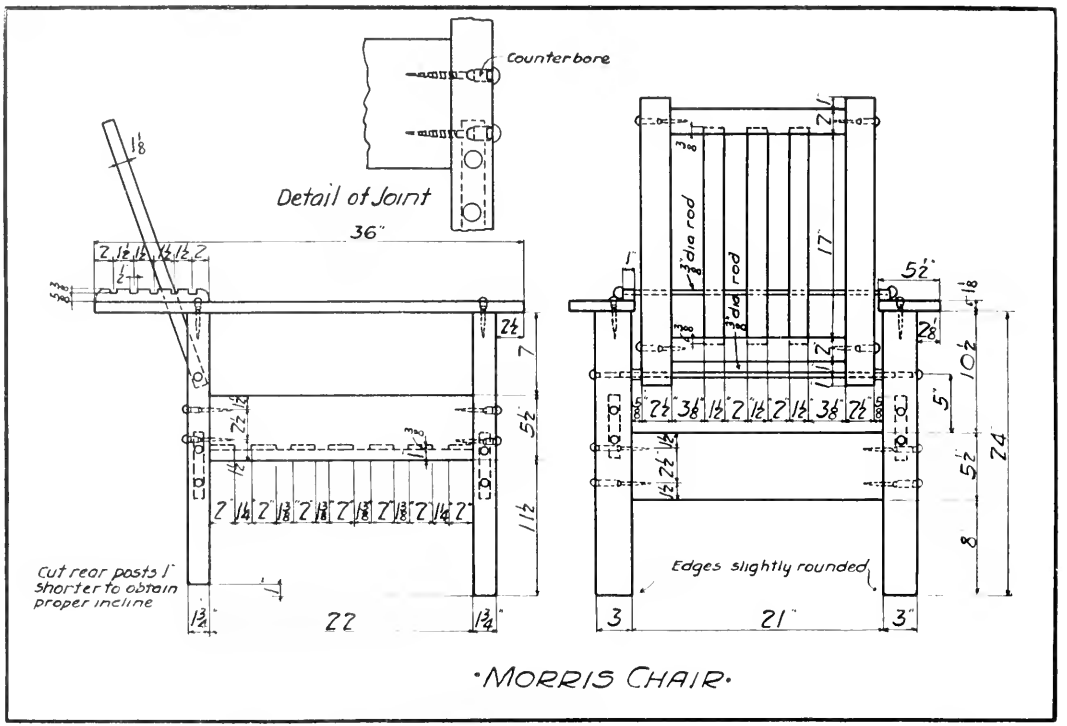

Counterbore
Detail of Joint
36"
Cut rear posts 1" shorter to obtain proper incline
22
Edges slightly rounded
21"
·MORRIS CHAIR·

PLATE 80

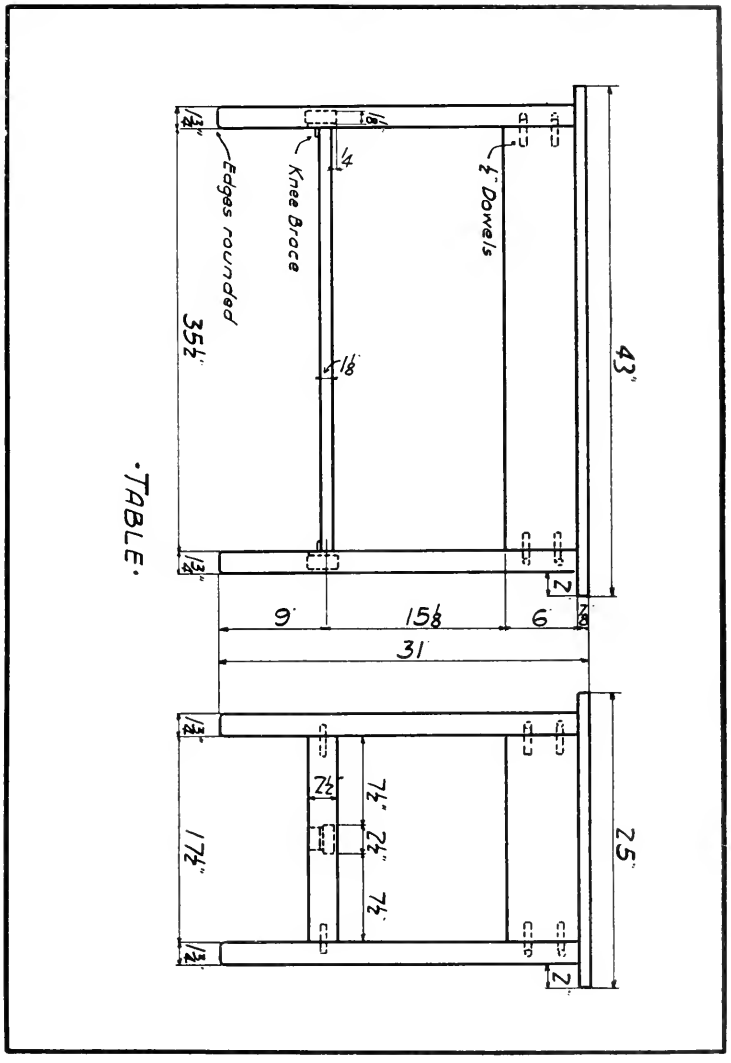


TABLE.
Edges rounded
Knee Brace
4
1" Dowels
35½"
1⅛
43"
9"
15⅛
6"
31"
7½"
7½"
7½"
17½"
25"

PLATE 81

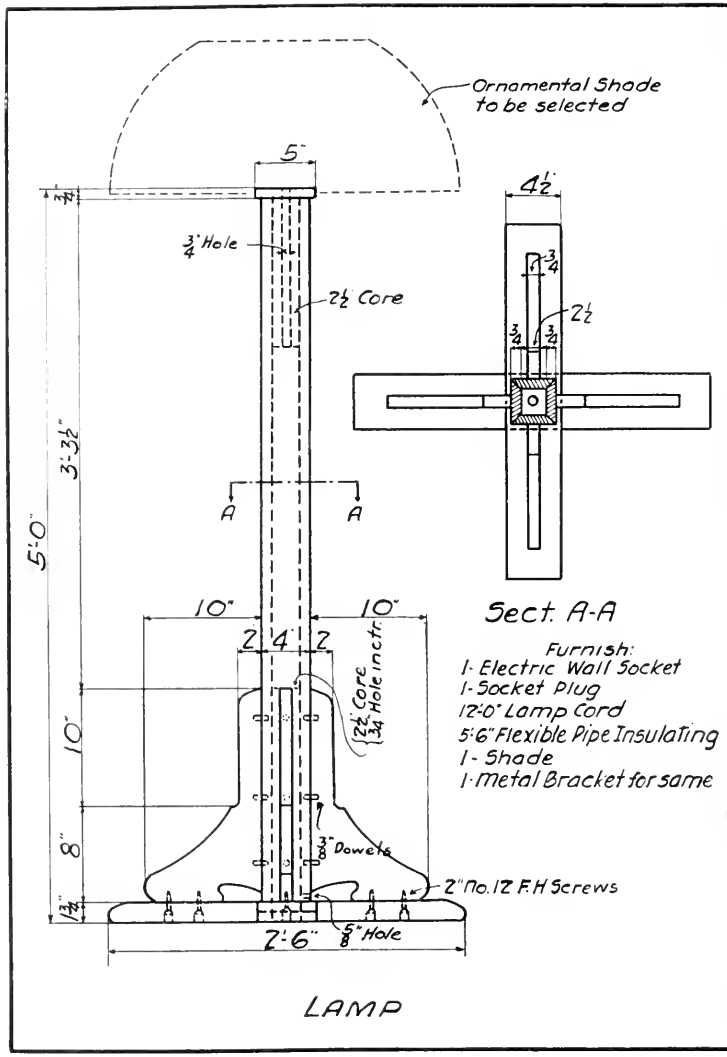

Ornamental Shade
to be selected
5"
4½"
¾" Hole
2½ Core
2½
A
A
5'-0"
3'-3½"
10"
10"
2
4
2
10"
8"
½"
2½" Core
¾ Hole inctr
¾" Dowels
2" No. 12 F.H Screws
7'-6"
⅝" Hole
Sect. A-A
Furnish:
1- Electric Wall Socket
1- Socket Plug
12'-0" Lamp Cord
5'-6" Flexible Pipe Insulating
1- Shade
1- Metal Bracket for same
LAMP

PLATE 82

A PROPOSED EQUIPMENT FOR CLASS OF TWENTY-FOUR

ARTICLE	QUANTITY
Automatic Boring Tool	1
Bevel, "T"	1
Bit, Auger, Jennings	1 set
Bit, Dowell, 3/8-inch	3
Bit, Dowell, 1/2-inch	2
Bit, Dowell, 5/8-inch	1
Bit, expansive	1
Bit, Gimlet, 2/32 to 7/32	1 set
Bit, Forstner, 1/2-inch	1
Bit, Forstner, 3/4-inch	1
Bit, Screwdriver, large and small	2
Bit Brace, common, 10-inch	3
Bit Brace, ratchet, 10-inch	1
Blade, Saw, coping	3 doz.
Blade, Jack Plane	10
Blade, Smooth Plane	10
Brushes, Counter	6
Chisel, 1/8-inch	2
Chisel, 1/4-inch	2
Chisel, 1/2-inch	6
Chisel, 5/8-inch	6
Chisel, 1-inch	24
Clamp, Colt's iron, 6-inch	6
Clamp, Colt's iron, 30-inch	4
Clamp, Wood, hand screw, 6-inch opening	8
Clamp, Wood, hand screw, 10-inch opening	6
Clamp, Wood Bar, 24-inch	3
Clamp, Wood Bar, 36-inch	3
Countersink	2
Divider, 7-inch	6
File, Flat Bastard, 8-inch	12
File, Half Round Bastard, 8-inch	12
File, Bit	1
File, Saw, slim taper, 5-inch	1
File Card and Brush	1
Frame, Saw, coping	12
Gouge, 7/8-inch	12
Grindstone	1
Hammer, bell faced	6
Knife, Chip Carving	12
Knife, Whittling	24
Mallet, rubber	12
Marking Gauge	12

ARTICLE	QUANTITY
Nail Set, assorted	6
Oiler, steel	6
Plane, Jack	24
Plane, Smooth	24
Punch, Carving, assorted	12
Rule, 4-fold, 2 ft.	24
Saw, Back	12
Saw, Panel	12
Saw, Rip	12
Saw, Turning, 14-inch	3
Saw, Turning, 12-inch	3
Saw, Turning, blade 14-inch	6
Saw, Turning, blade, 12-inch	6
Scraper, Gooseneck, 2½x5-inch	3
Scraper, Cabinet, sq., 2½x5-inch	6
Screwdriver, 7-inch	6
Spoke Shave, common	6
Slip, Stone, India	1
Stone, Oil, India	6
Trysquare, 7½-inch	24
Wrench, Monkey, 8-inch	1

DRAWING TOOLS FOR A CLASS OF TWENTY-FOUR

ARTICLE	QUANTITY
Compass, 4-inch	24
Compass, Blackboard, 18-inch	1
Drawing Board, 12 inch by 17 inch	24
Pencils, Drawing, 3H	36
Scale, 12-inch	24
Tee Square, 17-inch	24
Thumb Tacks	1 gross
Triangle, 60°, 9″	24
Triangle, 45°, 7″	24

SUGGESTED EQUIPMENT FOR FINISHING

ARTICLE	QUANTITY
Brushes, 1″ Rubber-set	3
Brushes, 1½″ Rubber-set	3
Iron Box, for waste and oil	1
Shellac Cup, cone top	6

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